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Bridging Gaps Between Conservation Action and Policy on Small Island Developing States – Case Analog of The Republic of Mauritius

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BRIDGING GAPS BETWEEN CONSERVATION ACTION AND POLICY ON

SMALL ISLAND DEVELOPING STATES

CASE ANALOG OF THE REPUBLIC OF MAURITIUS

A DISSERTATION

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We hereby approve the Dissertation

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ABSTRACT

BRIDGING GAPS BETWEEN CONSERVATION ACTION AND POLICY ON

SMALL ISLAND DEVELOPING STATES – CASE ANALOG OF THE REPUBLIC

OF MAURITIUS

by Pricila Iranah

Mauritius, a small island state in the Indian Ocean, is a biodiversity hotspot with highly

threatened forest ecosystems. It is also a country where environmental and conservation

programs have been successful in the past. However, the issue of funding has received

relatively less attention and national park systems are chronically underfunded. As part

of assessing the potential for local funding, we assessed the demand for forest recreation.

Recreation in forest ecosystems is one of the cornerstones of modern nature-based

tourism. Tourism is increasingly a favored tool to promote conservation of natural

forests, especially in developing countries where conservation financing can be

intermittent. At policy level, stakeholders on the island have limited opportunity to

translate conservation policies they help formulate into direct action. Enhancing the

stakeholder engagement process is all-the-more relevant on a small island developing

state where differences in gender, income, ethnicity interplay with differences in resource

access and power distribution.

Our study is organized in three core chapters. In Chapter 2 we explored means of

ensuring and enhancing conservation funding on the island. To that end, we designed

and administered survey based contingent valuation approach to estimate the willingness

to pay for conservation of state and privately owned forested sites. Study results suggest international and domestic tourists have a mean willingness to pay of USD 7.73 and USD 3.74 respectively, for conservation. These values represent amounts that visitors are willing to pay for conservation every time they visit a public or private forested site. Results show that education and mid-level supervisory roles positively influence willingness to pay values. Study results also show that people aged 50 and above, not having any supervisory role, married with one child or less, tend to have lower willingness to pay for conservation.

In Chapter 3, we focused on the contribution of domestic tourism to the conservation potential of native forests in the small island developing state of Mauritius. Our study used individual travel cost data from 188 residents, collected from in-person surveys at nine forested areas on the island. Results indicate that the consumer surplus for nature-tourism ranges between USD 3,739.21 and USD 3,975.54 per person per year. Our models also show that visit rates, and therefore residents' investment into tourism activities in forests, can increase with better sensitization campaigns and better understanding of the role played by forestland managers. Our most conservative estimate gives native forests of the island an annual recreation value of USD 260 million.

The third aspect of our study, explored in Chapter 4, used analytic hierarchy process (AHP), in combination with an analysis of strengths, weaknesses, opportunities and threats (SWOT) associated to conservation programs and policies developed on the island. Our findings present a robust overview of stakeholder preferences by establishing their priorities and assessing existing conflicts. Our findings show that state and private

stakeholders favor expansion of existing nurseries and the setting up of new ones to increase re-afforestation programs. The opportunities to raise funds through corporate social responsibility and nature-based tourism are also prioritized in their chosen strategies. Refining identification and management of invasive species remain a priority for the scientific community. Other stakeholders view their continued participation in conservation policy formulation as a strong factor to keep building upon, but seek to address the lack of legal enforcement in forestlands as well as development threats to environmentally sensitive areas.

Our study contributes to the literature by empirically assessing willingness to pay for conservation between and among international and national tourists visiting forest sites in Mauritius and developing an approach for determining predictors and mean willingness to pay values. We show that conservation strategies can extract greater benefit from the stakeholder engagement processes of formulating conservation policy by integrating AHP and developing outcomes that have better stakeholder buy-in than a one-size-fits-all solution.

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To my dad

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List of Acronyms and Abbreviations

AHP	Analytical Hierarchy Process
CBD	Convention on Biological Diversity
CMA	Conservation Management Area
CSR	Corporate Social Responsibility
CV	Contingent Valuation
ESA	Environmentally Sensitive Areas
FAO	Food and Agricultural Organization
FS	Forestry Service
GDP	Gross Domestic Product
GEF	Global Environmental Facility
IAS	Invasive Alien Species
IPCC	Intergovernmental Panel on Climate Change
IUCN	International Union for the Conservation of Nature
MID	Maurice Ile Durable

MOESD	Ministry of Environment and Sustainable Development
MOENDU	Ministry of Environment and National Development Unit
MTPA	Mauritius Tourism Promotion Authority
MUR	Mauritian Rupee
NBSAP	National Biodiversity Strategy and Action Plan
NGO	Non-Governmental Organization
NIASSAP	National Invasive Alien Species Strategy and Action Plan
NPCS	National Parks and Conservation Service
PAN	Protected Area Network
SIDS	Small Island Developing States
SWOT	Strength Weaknesses Opportunities and Threats
TCM	Travel Cost Method
UN	United Nations
UNCTAD	United Nations Conference on Trade and Development
UNDP	United Nations Development Program

UNOHRLLS	United Nations Office of the High Representative for the Least Developed Countries, Landlocked Developing Countries and Small Island Developing States
UNICEF	United Nations Children's Fund
US	United States
USD	United States Dollar
WTP	Willingness to Pay

1 INTRODUCTION

1.1 Small Island Developing States

Small Island Developing States (SIDS) are defined as a "*distinct group of developing countries facing specific social, economic and environmental vulnerabilities*" (United Nations Office of the High Representative for the Least Developed Countries, Landlocked Developing Countries and Small Island Developing States [UN-OHRLLS], 2011). SIDS have a number of common characteristics, namely their small size, geographical dispersion, greater vulnerability to rapid and drastic environmental change, limited administrative and technical resources (United Nations Conference on Trade and Development [UNCTAD], 2004). Members of the SIDS network range from the largest size of 426,840 km^2 (State of Papua, New Guinea) to the smallest size of 21 km^2 (Nauru, Pacific) (Neale, 2006) and range from high income to least developed countries. Within an already restricted land space SIDS have to accommodate urban and agricultural areas, as well as enough forest cover to keep providing essential ecosystem services, recreational and traditional benefits. Thus, SIDS are a laboratory case of issues affecting the developing world.

1.2 Role of forests on SIDS

Sea surface temperatures across the Indian Ocean have shown an increasingly warming trend over multiple decades (Alory *et al.,* 2007). Surface land temperatures for countries of the Western Indian Ocean have also increased, but total annual rainfall has decreased over 48 years, and the number of consecutive dry days has increased (Vincent *et al.,*

2011). The Inter-Governmental Panel on Climate Change (IPCC) Fifth report however predicts a one to nine percent increase in precipitation over the Indian Ocean for a scenario with 500-700 ppm of CO_2 emissions (Nurse *et al.,* 2014).   Increases in temperature and changes in precipitation can lead to more flooding and erosion events (Trenberth, 2008); especially in areas experiencing forest loss (Bradshaw *et al.,* 2007). Preserving native forests on islands is important in maintaining essential ecosystem goods and services, like provision of fresh water, prevention of soil erosion (Maina *et al.*, 2013) and for capturing atmospheric carbon (Bolin and Sukumar, in Watson *et al.*, 2000).

1.3 Threats to forests on SIDS

Four SIDS were listed amongst the top ten countries with three percent or more deforestation per annum in 1990 and 2000 (Wilkie, *et al.,* 2002). Malay and Philippines archipelagos, including Timor Leste and New Guinea have lost one percent of their rainforests annually between 2000 and 2010, with lowland evergreens and peat swamps disappearing faster (Miettinen, *et al.,* 2011). Madagascar lost 40 percent of its forest cover between the 1950s and 2000 with severe impacts on its endemic biota (Grady *et al.,* 2007).   Forests on island states make up less than one percent of the global forest coverage (Wilkie *et al.,* 2002) – which stands at 1.5 billion hectares (Achard *et al.,* 2014) - but provide invaluable goods and services to about 66 million islanders (House, 2013). Kier *et al.* (2009) found that plant endemism richness on islands is 9.5 times than mainland regions, showing that conservation of terrestrial ecosystems on islands are of prime importance. Human activity (Gibson *et al.,* 2011), invasive alien species (IAS) (Vitousek *et al.,* 1997), habitat destruction and fragmentation (Brooks *et al.,* 2002), dense

human populations (McKee *et al.,* 2004) and increasingly climate change (Loope and Giambelluca, 2009; Fordham and Brook, 2010) are amongst the many factors that particularly threaten island biota.

1.4 Protecting forests on islands

Since the 1970s, rates of biodiversity loss have increased, and rates of consumption of natural resources have increased, along with increasing spread of invasive species and increasing habitat fragmentation worldwide (Butchart *et al.,* 2010). The Convention on Biological Diversity (CBD) set targets in 2002 for a "*significant decline in biodiversity loss by 2010*", followed by the Aichi Biodiversity Targets for the period 2011-2020 (CBD, 2014); targets that have not been met. This has, in part, been attributed to a lack of financial resources, exacerbated by incomplete, thorough country-level data (Waldron *et al.,* 2013).

The most underfunded countries with regards to conservation are located within the tropical belt as shown in Figure 1 below. Out of those, SIDS collectively received around 2.4 percent of the 1.2 billion USD allocated globally to conservation for the period 2001-2008 (Waldron *et al.,* 2013; Miller *et al.,* 2013).

Traditionally, conservation comes from public financing through state agencies and creation of conservation funds with financing coming from a range of green taxes e.g., carbon or plastic or pollution taxes, and - more recently - ecotourism (Indufor, 2010). Conservation costs range from USD 130 to more than USD 5000 per km^2 per year in regions of Latin and Central America, Africa, and Asia (Balmford *et al.,* 2003). The high variability of costs, coupled with insularity and high biodiversity levels, suggests that SIDS need to be at the forefront of conservation interventions and strive to be more self-reliant in terms of conservation financing.
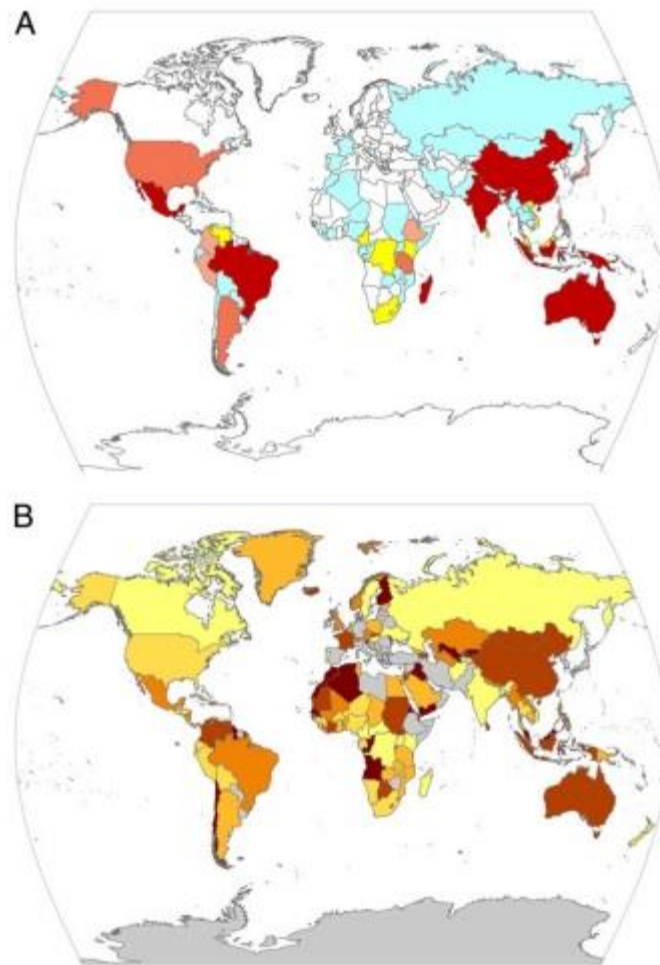
Legend for A: ☐ very low threatened biodiversity ☐ low threatened diversity ☐ medium diversity ☐ to ◼ high diversity

Legend for B: ☐ to ◼ levels of underfunding from bad to worst

Figure 1. In (A) using mammalian species as a proxy, Waldron *et al.* (2013) show the differences in levels of threatened global biodiversity stewarded by each country. In (B) Levels of underfunding by country with darker colors indicating least amount of funding (Waldron *et al.,* 2013)

1.5 Study Aims

Given the growing financial constraints on conservation worldwide and increased awareness of SIDS, the need to implement and prioritize conservation related policy interventions has become all the more challenging. Policies for SIDS needs to use adaptive mechanisms built on local knowledge, flexible governance, self-regulation and diversification of livelihoods (Lauer *et al.,* 2013). Our study therefore sought to address the following questions.

1. What is the willingness to pay for conservation in SIDS?

2. What is the value attributed to forests by people living in SIDS?

3. What factors influence decision-making and stakeholder preferences towards conservation initiatives?

Altogether, we expect these three intertwined objectives to facilitate a self-funding sustainable conservation model for SIDS. To address these aims, we focused our study on the Republic of Mauritius, an upper middle income SIDS that is also within one of the most bio-diverse hotspots of the world (Myers *et al.,* 2000). Mauritius was amongst the first countries to ratify the Convention on Biological Diversity in 1992, following which several in-situ and ex-situ conservation practices have been set up (National Biodiversity Strategy and Action Plan [NBSAP], 2006), whilst at the same time increasing state and private investment in rapid development. Specifically, our objectives were:

1. Assess the potential for state and private lands in Mauritius to use entry fees as a way to leverage conservation funds.

2. Assess the recreation value of forests in Mauritius as a means of placing a dollar value on their worth.

3. Assess the priorities of a range of state and private stakeholders in Mauritius with respect to forest conservation.

Chapter 2 addresses the first objective, for which we designed and administered a survey-based contingent valuation approach to estimate the willingness to pay for conservation of state and privately owned forests. Chapter 3 addresses the second objective for which we used a revealed preference survey-based approach to obtain individual travel cost data from residents, collected at nine forested areas on the island. Chapter 4 addresses the third objective for which we used strengths, weaknesses, opportunities and threats (SWOT) analysis combined with analytic hierarchy process (AHP) to assess preferences and priorities of local stakeholders with regards to terrestrial conservation management. Chapter 5 presents the conclusions drawn from the studies, the implications for environmental policy, study limitations and the potential for future work.

1.6 Study Area

1.6.1 Location and Geography

Mauritius, an island of 1,856km^2, is part of the Mascarenes archipelago, together with Reunion and Rodrigues. It is located about 900km east of Madagascar (Saddul, 1995), as shown in Figure 2, between latitudes 19°50' and 20°51' South, and between longitudes 57°18' and 57°48' East. The island has a tropical humid climate with average temperatures between 20.4°C (winter) and 24.7°C (summer) (Mauritius Meteorological Service, 2017). The island terrain comprises of a surrounding coastal plain that rises up to mountain ranges that encircle a central plateau. Mauritius formed volcanically around 7.8 million years ago (McDouglall and Chamalaun, 1969 in Strahm, 1993). The primary crater is still distinguishable from a chain of mountains running from the Black River Ranges with the highest peak at 828m, to the Moka Range and to some isolated peaks in between (Saddul, 1995).
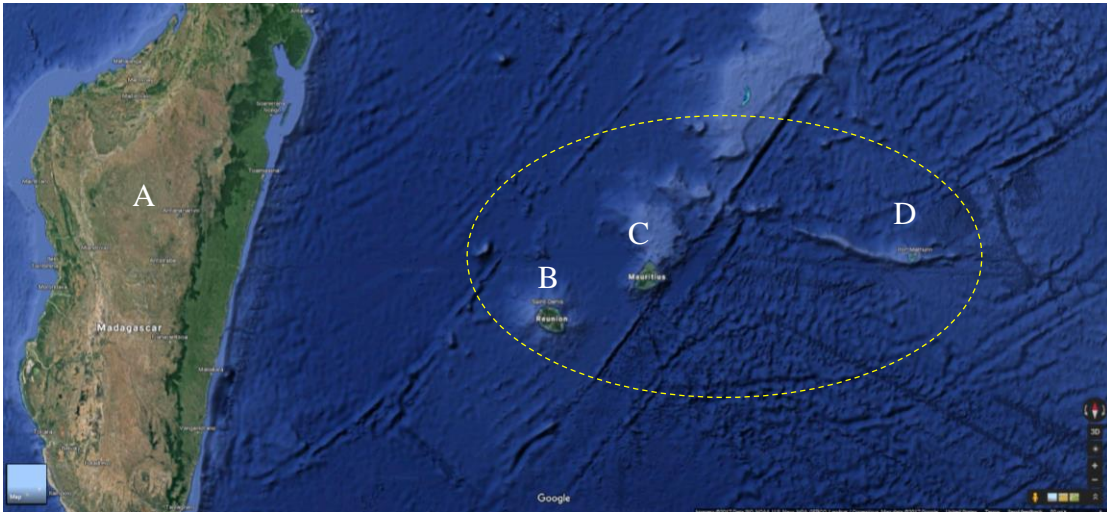
Figure 2: Location of Mauritius (C) relative to Madagascar (A), from Google^{TM} Maps (2017). Encircled is the Mascarene archipelago with Reunion (B) and Rodrigues (D).

1.6.2 Society and Economy

Arab and Portuguese sailors had the Mascarene Archipelago on their routes since the tenth century. Mauritius was first colonized by the Dutch from 1638 to 1710, during which time they exploited the island for its ebony wood, palm and animals (Brouard, 1963). The next colonization periods saw the island occupied by the French and the British from the 18th century until independence in 1968. Throughout this period large expanses of forest land were cleared for agriculture, timber production and settlement. Colonization saw the arrival of slaves from Madagascar and East Africa, followed by the arrival of indentured laborers from India once slavery was abolished on the island in 1835. Mauritian society today is a multi-cultural, multi-ethnic, multi-lingual society

made up of descendants of French and British colonizers, slaves, indentured laborers, as well as Chinese tradesmen.

Post-independence, the Mauritian economy was centered on agricultural export (mainly sugarcane), followed by textile and clothing manufacturing, all of which were dependent on significant foreign direct investment and preferential markets in Europe (Sobhee, 2009). From the 1990s, the economy diversified towards construction, tourism and the financial sector. Trend in economic indicators for the island are as follows: (i) real Gross Domestic Product (GDP) grew by 5.2 percent between 1977 and 2006 (ii) average income increased three times in that same period (iii) life expectancy at birth increased from 61 years in 1965 to 73 in 2005 (iv) Gini coefficient declined from 0.5 in 1962 to 0.34 in 2004 (v) consumer price inflation averaged 8.7 percent per year between 1976 and 2006 (Subramanian, 2009). The island is today classified as an upper middle income country with a gross domestic product of USD 12.2 billion (The World Bank, 2016), for a population of 1.3 million (Statistics Mauritius, 2016).

1.6.3 State of forest ecosystems and their conservation

Colonization also saw the introduction of alien plants and animals like the Chinese guava (*Psidium cattleianum*), the Traveller's Palm (*Ravenala madagascarensis*) and the Indian Mynah (*Acridotheres tristis*) (Brouard, 1963), most of which are now major invasive species, threatening native biota on the island. With time, development and lifestyle changes, Mauritius has seen a rapid decline in forest cover with the percentage of forest bearing at least 50% native canopy, drastically reduced from 85 percent of the island's surface area in the 1700s to under two percent in late 1990s (Vaughan and Wiehe, 1937; Page and D'Argent, 1997), a decline shown in Figure 3.
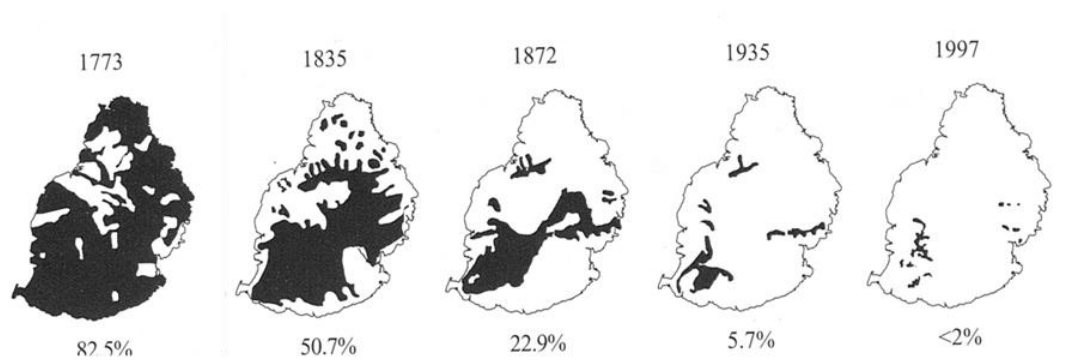
Figure.3. Loss of native forest cover on Mauritius between the late 1700s to the late 1900s. (Vaughan and Wiehe, 1937; Page and D'Argent, 1997)

Native forests left on Mauritius are now surrounded by urban, industrial and agricultural development (National Biodiversity Strategy and Action Plan [NBSAP], 2006), with land use distributions shown in Figure 4. They are mostly located on mountain ranges and other hill slopes that could not be converted to agriculture or urban land-uses. More information on the distribution of forest remnants are given in Table 1.

Land use distribution in km^2
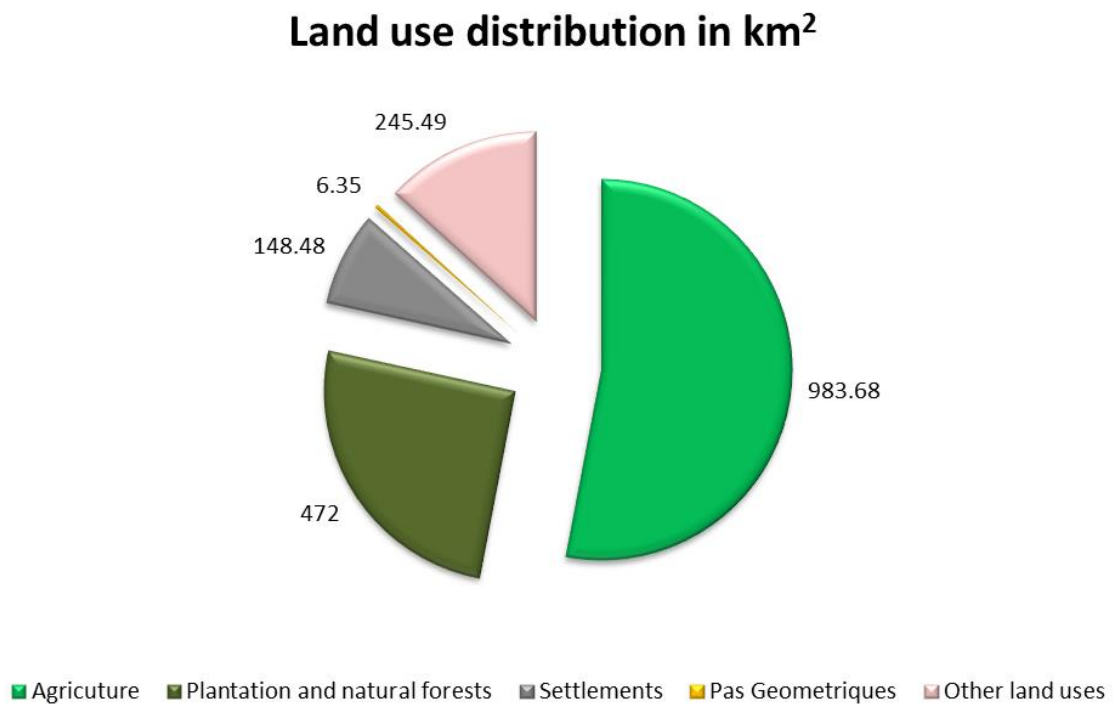
Figure 4: Land use distribution for mainland Mauritius. Numbers are land areas in km^2.

The spread of IAS encourages further habitat degradation and fragmentation (Vitousek *et al.,* 1997). When combining these conditions to ecological impacts like loss of natural dispersers or pollinators as well as increased distance from source populations, the extinction of species left within fragments increases (Gibson *et al.,* 2013). Yet, Mauritian native forests retain the highest tree diversity of the Mascarene region (Florens *et al.,* 2012) and are home to 12 native forest birds, 9 of which are endemic (NBSAP, 2006). The island bears 691 species of native flowering plants of which 273 are endemic to Mauritius only, and about 150 species are endemic to the Mascarenes (Baider *et al.,* 2010).

Table 1: Distribution of protected areas, private forest lands, state owned forest lands, leased forest lands and forest lands with deer ranching on the mainland. Information sourced from UNDP-GEF (2009) and NBSAP (2006)

		State owned and managed (km^2)	Leased or Privately owned (km^2)
Total Area		221.84	250.16
Protected Areas	Black River Gorges National Park	65.74	
	Bras d'Eau National Park	4.972	
	Perrier Nature Reserve	0.0144	
	Les Mares Nature Reserve	0.051	
	Gouly Pere Nature Reserve	0.1095	

	Cabinet Nature Reserve	0.1773	
	Bois Sec Nature Reserve	0.0591	
	Le Pouce Nature Reserve	0.688	
	Corps de Garde Nature Reserve	0.9033	
	Rivulet Terre Rouge Estuary (Ramsar Site)	0.26	
	Mountain reserves		38
	River reserves		27.4
	Mondrain private reserve		0.05
	Emile Series private reserve		0.08
>50% native canopy			26
Plantation forests		118.16	26
Land with deer	State owned and managed	69.3	
	State owned – Leased		30.7
	Privately owned		150
Undisclosed land use			8.63

Mauritius has been a forerunner in implementing conservation measures. It was one of the first countries to ratify the CBD in 1992, following which several in-situ and ex-situ conservation practices have been set up (NBSAP, 2006). In-situ conservation practices involve creating Conservation Management Areas, active weeding of invasive alien plant species, trapping of invasive alien animal species, captive native bird breeding programs and provision of supplemental feeding for released native birds. Ex-situ conservation practices include native plant propagation in nurseries, maintaining a native arboretum and herbarium collections. The island bears twelve formal state protected areas on the mainland which are two National Parks, seven Nature Reserves, one Forest Reserve, one Bird Sanctuary, one Ramsar site, in addition to nine offshore islet protected areas, covering a total area of 80.27 km^2 (United Nations Development Program-Global Environment Facility [UNDP-GEF], 2009; Government Information Service [GIS], 2011). The Nature Reserves, Forest Reserves, as well as river and mountain reserves, are managed by the Forestry Services (FS), whilst the National Parks and Conservation Service (NPCS) oversees the management of the National Parks, most offshore islet Nature Reserves, the Ramsar site and Ancient Monuments. The main conservation strategy used by state agencies is the creation of Conservation Management Areas (CMA), where patches of good quality forest are fenced off and cleared of all invasive alien plant species within them. Since the setting up of the first CMA in 1987 covering 0.012km^2 (Baider and Florens, 2011), today the fenced CMAs cover some 0.6km^2 (NBSAP, 2006). A more detailed discussion of CMAs as a conservation tool is provided in Section 2.1.

With regards to private lands, about 65.53km^2 under forests are classified as Mountain Reserve or River Reserve under the Forest and Reserves Act of 1983. Enforcement of regulations or conservation activities in those reserves is limited and private landowners lack technical and financial incentives to invest wholly in IAS control or the setting up of CMAs on their lands (Seewoobaduth *et al.,* 2005).

Mauritian forests are still heavily threatened. By 2021, it is estimated that approximately 122km^2 of land will be needed for additional urban, business and infrastructural development (Ministry of Environment and Sustainable Development [MOESD], 2011), making land-use change a substantial pressure on forest lands. However, IAS present the greatest biological threat to Mauritian biota, such that their control and eradication is the major component of forest restoration and conservation for the island. Florens (2013) showed that investing in forest restoration by removing invasive alien plants alone can bring about strong positive effects on both native plants (Baider and Florens, 2006, 2011; Monty, Florens and Baider, 2013) and animals (Florens and Baider, 2007; Florens *et al.*, 2010; Hugel, 2012), and this at lower costs than required by traditional setting up of fenced CMAs.

1.6.4 Conservation financing in Mauritius

The Wildlife and National Parks Act (1994) catered for the creation of the National Parks and Conservation Fund. Money for this fund comes from a USD 75/head tax on the export of F1-generation *Macaca fascicularis* for vivisection (Greenwood, 2008). This funding is used for all expenses incurred by the NPCS, and any additional annual funding is secured through Government budget. There is no disclosed information on the actual allocation of funds within the NPCS and therefore it is hard to establish the minimum amount that goes specifically to forest restoration work on an annual basis, as opposed to salaries, office maintenance or other expenses. Additional local sources of funding for the NPCS come from export and import permits under the Convention against Illegal Trade in Endangered Species (CITES) and sales of nursery-grown native plants (CBD, 2003). Additional biodiversity funding (amount unknown) comes from the National Environment Fund created under the Environment Protection Act (1991) (CBD, 2003).

In terms of donor funds (whether the donors are international agencies or local bodies), if a project falls within the jurisdictional range of the Director of the NPCS, then the NPCS can receive part of the funding and act as lead agency, even if implementation goes to a non-governmental organization or other third party (CBD, 2003). Mauritius has been receiving international funding from the GEF for over 14 years, disbursed through the World Bank, the United National Environment Program (UNEP), the UNDP and the Food and Agricultural Organization (FAO) (CBD, 2003). This GEF funding - to the tune of USD 270,000 per year - went to marine conservation and to energy management projects in Rodrigues, amongst other areas, including biodiversity conservation (CBD,

2003). The island obtained about USD 43 million from the European Commission's European Development Funds, but which went mostly to waste water management (CBD, 2003).

The Government of Mauritius allocated about USD 35 million annually to recurrent and capital expenditures on fisheries, environmental management, parks management, agricultural services, waste water management, agricultural research and extension program, as well as support to non-governmental organizations (CBD, 2003). The forest biodiversity-related allocations go to both the NPCS and the FS. Another report to the CBD dated 2014 highlights that Government budget allocations were to the tune of USD 38 million for the NPCS and USD 97 million for the FS.

Lastly, the 2003 report to the CBD recognized that the private sector in Mauritius has contributed to biodiversity conservation, but does not give the levels of those contributions. In 2009, the Ministry of Finance sought to formalize the contributions of the private sector and introduced a Corporate Social Responsibility (CSR) program that gave corporate bodies the option to direct two percent of their annual book profits towards projects that would bring social and environmental benefit to local communities, otherwise these two percent would be collected by the state (PriceWaterhouseCoopers, 2010). There is however no clear documentation on how much of this CSR funding has specifically gone to forest conservation activities, since the inception of this program.

The Government of Mauritius has set itself the target of turning the island into a high-income economy by 2020 (GIS, 2016; Fakun and Jaddoo, 2017). However, it is expected that the flow of international aid to Mauritius will eventually decline in favor of lower

income countries (Paupiah, 2004). The 2003 report to the CBD on biodiversity-related

spending in Mauritius recognized that most conservation activities are financially

supported by the Government and various legislative funds, but funding was still limited.

With budgetary allocations already deemed insufficient, investigating means to

complement current funding sources for conservation is of importance, especially as

concern for protecting forest areas increases, both for nature-tourism opportunities and in

response to social pressures on mitigating impacts of climate change.

1.6.5 Forest Uses on the Mainland

Unlike most of the Pacific and Caribbean islands, the Mascarenes bear no indigenous

human populations, with all populations that reached Mauritius over the last 300 years

coming from Europe, Asia and Africa, creating the baseline for its multi-ethnicity and

multi-culturality (Paupiah, 2004). During and immediately post-colonization, people

established on the island relied on forest products, principally for fuelwood and timber.

Traditional knowledge of slaves and indentured laborers has expanded to a number of

native medicinal plants (Rouillard and Gueho, 1999), many of which are now well-

documented, for example, antiplasmodial and anti-inflammatory effects of *Aphloia*

theiformis and *Nuxia verticillata* (Jonville *et al.*, 2011). Modern-day Mauritians bear

little to no direct link to, or reliance upon, native forests for survival. However plantation

forests and some areas of the National Parks are highly favored by residents as picnic and

hiking spots, as well as for collection of *Psidium cattleianum* and *Rubus rosifolius*

berries, a habit now well encroached in the local culture, despite these two species being

IAS. State lands that are under the purview of the FS and NPCS, for the most part can be

accessed at no cost by members of the public but there is a dearth of annual visitor

counts. Even then, many of the Nature Reserves and Forest Reserves remain largely

unknown and not easily accessible to the public, with the exception of the National Parks

(fruit picking, hiking, trail running), Le Pouce Nature Reserve (mountain climbing) and

Corps de Garde Nature Reserve (mountain climbing). Private forest lands and some

mountain and river reserves on private lands are also popular with visitors as they bear

nature-tourism operators.

Mauritius offers a set of enabling conditions (favorable economy, existing and upcoming

legal implements, value attached to biodiversity and natural areas, long standing history

of biodiversity research) to successfully develop and test a scientific and socio-economic

model in favor of greater and more sustainable conservation of native forests.

1.7 Research Methodology

1.7.1 Objective 1 – Stated Preference Method: Contingent Valuation

Objective 1 is addressed in Chapter 2 using a stated preference based non-market

valuation method, namely contingent valuation (CV). The contingent valuation approach

has been used successfully in various settings and places a monetary value that people

attach to goods or services by directly eliciting response contingent on a set of conditions

(Lal *et al.,* 2017). Surveys help estimate peoples' willingness to pay (WTP) for the

provision of utility from nature, for which market prices may not exist, (King and

Mazzotta, 2000). The method relies on creating a hypothetical market for the good

and/or service respondents are being asked to value. This method has been extensively

used in valuing recreation, ecosystem services and other benefits perceived by populations affected. For example, results of a CV survey in the Murchison-Semliki landscape in Uganda showed that households were willing to accept USD 630/ha/year as compensation for preserving corridor forests (Wildlife Conservation Society, 2010). Nuva *et al.* (2009) used a CV approach, to assess visitors' WTP as an additional entry fee to the Gunung Gede Pangrango National Park in Jakarta, concluding that the mean WTP was RP 7629.77 (USD 0.57 at 2017 exchange rates) per visit and influential factors were gender, income and where they lived. Alvarez and Larkin (2010) used an open-ended CV survey, alongside revealed preference methods, to estimate the WTP for restoration of the Los Nevados National Park in Colombia following wildfire damage. They found that higher entry fees may not be enough towards a one-time investment into restoring all 2,500 ha, but may efficiently fund on-going small-scale restoration projects. Mwebaze *et al.* (2010) found that tourists in Seychelles were willing to pay between USD 50 and USD 57 on top of usual entry fees, towards a conservation fund dedicated to prevention measures against invasive alien species.

National parks and forest reserves in Mauritius are free of charge to members of the public, except for areas specifically closed off. Eco-tourism sites on privately-owned forest lands bear an entry fee but these cover maintenance and personnel costs. The WTP for conservation was to domestic and international tourist visitors in the form of either paying an entry fee to state-owned forested areas, or paying an extra amount to sites that are already charging an entry fee.

1.7.2 Objective 2 – Revealed Preference Method: Travel Cost Method

Objective 2 is addressed in Chapter 3 using a revealed preference based non-market

valuation method, namely travel cost (TCM). TCM uses travel costs of visitors to

estimate the recreational value of a site. The three types of travel cost methods are the

utility-based TCM, zonal TCM and individual TCM. Benson *et al.* (2013) used TCM

with a zero-truncated negative binomial regression and K-means cluster analysis to assess

benefits that users (n=580) with differing activity preferences, gain from visiting

Yellowstone National Park. They found that summer visitors derived between USD 276

and USD 235 per person per trip in benefits from the park. Shrestha, Stein & Clark

(2007) assessed 237 visitors' demand for nature-based recreation in the Apalachicola

River region (USA) using TCM and showed that mean WTP was USD 74.18 per visit per

day, equivalent to USD 484.56 million per year. Pirikiya *et al.* (2016) used TCM to

establish that the recreation value of Shahid Zare Sari Forest Park in Iran is about USD

52,558 per hectare per year, based on 302 individual responses. Ezebilo (2016) used

mailed-in TCM survey data to establish that visitors to nature areas in Sweden had a visit

frequency of 80 times per year, with a travel cost of USD 16 per person, per visit.

Bartczak *et al.* (2012) used on-site survey of 1128 respondents to establish that visitors to

forest areas in Poland had a consumer surplus between USD 3.12 and USD 5.62 per

person, per visit. TCM has also been successfully used to estimate the economic value

attached to marine parks (Chae *et al.,* 2012; Mwebaze & MacLeod, 2013), coral reef

systems (Carr & Mendelsohn, 2002; van Beukering, *et al.,* 2015; Seenprachawong, 2016)

and other coastal protected areas, but there is limited literature on the application of TCM

to value forested landscapes on SIDS. In our study, we used the travel cost method to assess the recreation value of Mauritian forests across the island, by targeting users at different sites and assessing their individual travel costs and demand for outdoor recreation.

1.7.3 Objective 3 – SWOT-AHP

Objective 3 is addressed in Chapter 4 where SWOT factors were compared to one another in a pairwise fashion using a 9-point scale system (Saaty, 1990). This allows for preference weights to be calculated for each SWOT and for those eights to show similarities or differences in preferences between different respondents. AHP has been successfully applied to assess the case for forest certification in Finland (Kurttila *et al.,* 2000); assess environmental and socio-economic indicators for all terrestrial Italian protected areas (Scolozzi *et al.,* 2014); assessing how local communities perceive community-based management for the Nyungwe Forest Reserve in Rwanda (Masozera *et al.,* 2006). These studies have already proven the use of SWOT-AHP in natural resource and conservation management, but there are limited studies on its application to inform forest conservation strategies in SIDS, a gap which our study seeks to address by focusing on the Republic of Mauritius and its conservation programs.

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2 VALUING VISITOR ACCESS TO FORESTED AREAS AND EXPLORING WILLINGNESS TO PAY FOR FOREST CONSERVATION AND RESTORATION

2.1 Introduction

Most SIDS countries are focused on economic and social development, such that conservation needs remain largely unmet. The unreliability of international aid towards conservation in the developing world means that the ability to leverage funds from tourists and residents to improve biota, can ensure greater success for conservation programs. This chapter explores individual willingness to pay for conservation of biota in the Republic of Mauritius.

As highlighted in Section 1.6.4, several areas of the National Parks, some Mountain and Nature Reserves and some privately owned forests in the country are favored as picnic and hiking spots, nature-based tourism as well as for collection of wild fruits. Even if state lands are for the most part free to members of the public, conservation and maintenance of native forest lands are cost-intensive. For example, conservation costs associated to setting up CMAs on state forest lands range from USD 10,000 (Dulloo *et al.*, 2002) to USD 13,000 per ha per year (UNDP-GEF, 2009, Florens *et al.,* 2010); adjusted to USD 16,064 and USD 20,883 respectively to reflect 2017 inflation and exchange rates (Mauremootoo, 2017). In their traditional form, CMAs are fenced plots of native forest land that are then weeded of invasive alien plant species. The base of the fencing is often lined with piles of small rocks to deter feral pigs. However, fenced CMAs have limits in their effectiveness. The requirements for fencing material, sturdy

wooden posts and heavy use of manual labor, limit CMAs to being located near truck-accessible tracks, therefore incorporating areas of forests prone to edge effect. This requirement also means that it is not always the most critical habitats that are enclosed, but rather those fitting convenience and location. In many instances, the CMAs enclosed deer and feral pigs (which they are supposed to keep out) whilst the fencing itself is not impervious to rats, feral cats, disease-prone alien bird species (Florens, 2013), nor to vandalism on public lands. Baider and Florens (2011) found that fencing was not actually significant in deterring introduced animals. They showed that focusing on improved weeding and contracting labor from local communities can not only reduce initial restoration costs to USD 1,000- USD 3,000 per ha, but also drastically improve the health of the ecosystem (Florens *et al.,* 2010; Florens and Baider, 2013). These costs were adjusted to fit 2017 inflation and exchange rates at USD 2,400 and USD 3,100 (Mauremootoo, 2017). As discussed in Section 1.6.4, diverting funds to active forest restoration through removal of invasive alien plant species can result in significant recovery for native species in terms of increased number of seedlings, increased recolonization of forest gaps by native pioneer species with potential positive ripple effects on the health of the ecosystem as a whole and for native animal and insect species (Florens 2013). Mauremootoo (2017) highlights that CMA costs (excluding fencing) go to paying salaries of laborers and supervisors; overhead costs associated to utilities and administrative salaries; rental of storage facilities for pesticides; transport costs of fuel and vehicle purchases; costs of tools and equipment used for weeding and data collection and lastly, costs of consumables like masks, gloves and herbicides. Private owners of

forest land tend to lack technical and financial incentives to invest towards setting up

CMAs or other consistent conservation programs on their lands (Seewoobaduth, *et al.,* 2005). If cost-saving measures are employed, the area of restored forest can be significantly increased. Alternatively, smaller amounts can be leveraged for effective restoration work with lower financial risk. It may also be easier for private forest landowners to divert smaller amounts of money to consistent conservation efforts, as opposed to waiting for one-off donations.

Strategies like payments for ecosystem services, government land retirement, conservation subsidy programs, conservation easements and tax incentives, in the country, are still in infancy. Hence, for Mauritius, using entry fees as a source of revenue for environmental conservation can act as a viable first-step towards improving services and increasing the quality of the experience that is valued by visitors to natural areas.

With regards to local funding, the government spends some USD 6.5 million on the NPCS, out of which an unspecified amount is allocated specifically to native forest restoration (NBSAP, 2006). State-owned forest lands, except for specifically restricted areas, are freely accessible to the general public. The demand from locals and tourists for nature-based tourism is significant, but updated and regularly published data on the total number of visitors per site per year is not available (Dr J. Mauremootoo, Personal Communication, 25 April 2015). Private forest landowners have, over the last decade, picked up upon the growing demand for nature-based tourism, opening their lands for paid activities e.g. guided treks, zip-lining, and quad biking. However, much of the money collected through these tourism ventures goes towards operational costs or as debt

payments for capital expenses. So far, no nature-based tourism operator has been able to redirect profits towards conservation activities. This study used a stated preference method to investigate whether nature tourism payments sourced from international and national tourists on private and public sites can be used to accrue revenue that can be used for forest conservation and restoration activities on the island. This study also discusses visitors' choices, socioeconomic determinants, and provides insights that can be used to enhance tourists' satisfaction and awareness as well as provides suggestion to improve tourist programs. The results from this study can help guide decision makers regarding improved natural resource and tourism management as well as increased revenue for conservation and restoration efforts.

2.2 Methodology

2.2.1 Study approach

Our study builds upon prior studies and assesses how much money visitors to state and private forest areas in Mauritius are willing to pay for forest conservation and restoration, either in the form of entry fees to sites where no such fees exists, or as an incremental fee to sites that already have preexisting entry fee. We are assuming that the willingness to pay values we estimate, are entry fees (or extra amounts) paid by an adult aged 18 and above, visiting an average forested area on mainland Mauritius.

2.2.2 Data collection

Respondents for this study were international and domestic visitors to forested areas in mainland Mauritius and surveys were conducted at public and private sites, elucidated in

Figure 5. The state-owned sites selected were the Black River Gorges National Park, the

Bras d'Eau National Park, Vallee d'Osterlog Endemic Garden, Le Pouce Nature Reserve,

Ile Aux Aigrettes Islet Nature Reserve and Trou aux Cerfs. Privately owned sites

selected were La Vallee de Ferney Forest and Wildlife Reserve, Le Domaine de l'Etoile

and La Vallee des 23 Couleurs. Every fifth adult visitor at each site was approached for

survey. Surveys were administered on weekdays as well as weekends between 2nd May

and 23rd August 2015. Survey responses were higher during weekends than on

weekdays, following established trend of more weekend visitors than the ones who visit

on weekdays.
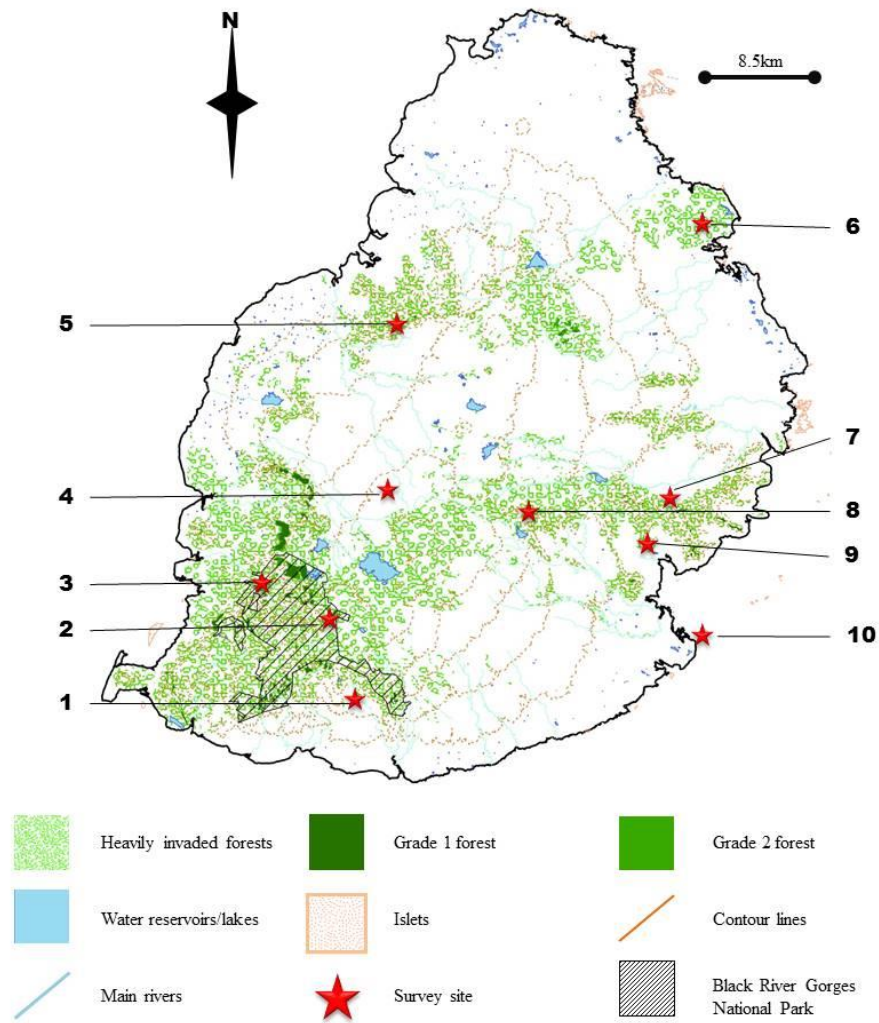
Figure 5: Approximate location of study sites at which CV surveys were conducted.

1 – La Vallee des 23 Couleurs; 2 – Upper Black River Gorges National Park; 3 – Lower

Black River Gorges National Park; 4 – Trou aux Cerfs; 5 – Le Pouce Nature Reserve; 6 –

Bras d'Eau National Park; 7 – Le Domaine de L'Etoile; 8 – La Vallee d'Osterlog; 9 – La Vallee de Ferney; 10 – Ile aux Aigrettes

2.2.3 Survey design

Expert local reviewers, chosen because of their experience on the topic and of the geographic area, and focus groups were conducted on the island to pre-test the survey instrument (see Appendix I) and improve comprehensiveness and understandability.

Because most state-owned and state-managed sites are freely accessible, a fully open-ended valuation could have resulted in very high or low WTP value. Using open-ended questions, in focus groups, we elicited fees respondents were willing to pay, which provided the range of values used to determine five fees (BID values) quoted in the final survey. We adapted the payment card method following Mitchell and Carson (1981) for this study. Entry fees charged at paid-for sites were compiled and broken into five BID values ranging from the lowest to the highest. One entry BID price, was presented to each respondent at state-owned as well as private sites. For sites already charging entry fees, the willingness to pay for conservation was framed as a conservation levy over and above the existing entry fee. Respondents at paid sites were offered the option of paying 10%, 25%, 50%, 75% or 100% extra, on top of the existing entry fee. The survey reminded respondents to give a realistic estimate of the additional amount they are willing to pay by taking into account their budget and maintaining their current spending pattern, as opposed to reducing duration of stay, for instance, to make up for the higher fee. The respondents were offered an opt-out option and were also provided the

opportunity to record their explanation. The payment values presented and recorded in the survey were in Mauritian Rupee but converted to US dollars in this chapter at August 2015 (end of study) prevalent rate of 0.03478 (Bank of Mauritius, 2016).

The introductory script of the survey explained the context of the study and explained the importance of better conserved and restored forests in terms of human health, freshwater and environmental aesthetics. The ensuing questions assessed respondents' existing knowledge of, and attitudes to, biodiversity-related topics. The third section presented a hypothetical scenario where visitors were explained that additional funds could support better forest conservation and help in the removal of invasive species. This section then enquired about their willingness to pay for better forest conservation to enhance provision of ecosystem services and protect wildlife. Similar to the work by Randall, *et al.* (1974) photographs (see Plates 1 to 6 in Appendix II) were used to give a visual aid to respondents in understanding a scenario with more forest conservation, versus one with low to none. Socio-economic background questions were asked in the last section of the survey. Surveys were conducted in English, French and Mauritian Creole.

2.2.4 Theoretical specification

For dependent variable p, the following function was estimated

$$p = f(X)$$

where $X = X_1, X_2, ..., X_n$, represents the set of variables that can explain a respondent's WTP. A regression model of the form

$$p = \beta_0 + \beta_1 X_1 + \beta_2 X_2 + \beta_3 X_3 + \beta_n X_n + ... + \varepsilon$$

can also be used to assess the relative strengths of various independent variables in influencing WTP bid values. In such a regression model, β_0 is the regression constant or y-intercept, whereas β_1, β_2… β_n are the coefficients for each variable X_1, X_2,…X_n respectively, and ε is a random error term. X_1 to X_n represent variables like age, gender, ethnicity, income range, education level, supervisory role, civil status, and number of children, amongst others. The direction and strength of the vector for any one variable expressed the significance of that variable at 95% and 99% confidence level was used to explain differences in WTP values. All data were analyzed using SAS JMP® Pro v.11.

We used the stepwise regression modeling approach to define the final models. Stepwise approach enables the optimal subset of variables to be picked up following an iterative optimization process. In general, a stepwise regression calculates the squared t-statistic for each variable, reporting it as a F-statistic. The statistical software measures if that value is a high enough F statistic to keep the variable, or low-enough to reject a variable from the model (Warner, 2008). We hypothesized that possible variables such as gender, annual income, level of schooling completed, age group, marital status, number of children, supervisory position in the workplace, number of hours spent at the site, mode of transport (private car or otherwise), purpose of visit to site, whether respondent was alone or accompanied and whether respondent was a domestic or international tourist could influence WTP. The regression model identified number of children, age, ethnicity, supervisory position and annual income as significant factors.

2.2.5 Revenue Requirements for Conservation and Restoration

The initial process of conservation and restoration in the country can be costly as it includes a first phase of invasive species management, comprising of weeding, animal trapping, tree guards, nursery set-up, tree planting, all taking place in the first year of a project. Mauremootoo (2017) highlights that the frequency of maintenance weeding decreases as the native vegetation gets re-established and associated costs can be annual or less frequent depending on site-specific factors and weeding techniques used. The NPCS' weeding costs are reported at USD 5,000 (adjusted to 2017 prices) per hectare for the first year of initial weeding, skimming down to USD 556 per hectare per year from the fifth year, and USD 278 per hectare per year from the tenth year, for maintenance weeding (Mauremootoo, 2017).In this study, we disregarded maintenance costs as it could be met from government and other grants and support programs, and assumed the funds that can be raised from visitor entry fees are used for initiating and expanding acreage of restoration activities only. In reality, some areas may have already initiated weeding activities and can use new funds earmarked for conservation towards maintenance weeding or any other activities. We used the mean WTP values calculated for domestic and international tourists, and the lowest and highest 95% confidence limits, to determine firstly, how much could be raised by targeting increasing portions of the visitor population; and secondly, how close state and private landowners can get to achieving biodiversity conservation targets set by the government.

2.3 Results and Discussion

2.3.1 Regression Model

Based on the stepwise regression approach outlined earlier, we arrived at the final model with variables outlined in Table 2 and the levels in which they were coded. The model could explain about 43.23% of the variance, with the regression output summarized in Table 3. The results suggested that on average, married people with at least one child, aged 50 and above, who were not Sino-Mauritians and had low level supervisory roles, would be willing to pay less than people in other demographic categories. Results also suggest that, respondents with an annual income between USD 12,000 and USD 18,000 were more likely to have a higher WTP values.

Table 2: Descriptive summary of CV model variables and how they were coded for data analysis

Variable	Levels	Type	Code
Number of children	None	Ordinal	1
	One child		2
	2 children		3
	More than 2 children		4
Age group	18 to 29 years old	Ordinal	1
	30 to 39 years old		2
	40 to 49 years old		3
	50 to 59 years old		4

Table 2: Descriptive summary of CV model variables and how they were coded for
data analysis

Variable	Levels	Type	Code
	60 years old and above		5
Supervisory role	I do not supervise	Nominal	1
	I am the lead worker in my unit		2
	I supervise a single unit employees		3
	I supervise two or more units, each unit having an individual supervisor		4
	I supervise a major division of an agency or department		5
	I supervise an entire agency or department		6
	I supervise more than one agency or department		7
Ethnicity	Franco-Mauritian	Nominal	1
	Indo-Mauritian		2
	Sino-Mauritian		3
	Creole		4
	Asian		5
	Caucasian		6
Marital Status	Single	Nominal	1
	Married		2

Table 2: Descriptive summary of CV model variables and how they were coded for data analysis

Variable	Levels	Type	Code
	Divorced/Separated		3
	Partnership		4
	Widowed		5
Annual	Less than or equal to 2,000	Ordinal	1
Income	Between 2,001 and 5,000		2
bracket (USD)	Between 5,001 and 12,000		3
	Between 12,001 and 18,000		4
	Between 18,001 and 30,000		5
	Between 30,001 and 50,000		6
	Between 50,001 and 100,000		7
	Between 100,001 and 150,000		8

Table 3. List of variables used to explain visitors' WTP

Predictor	Level Comparisons	Estimate	Prob > |t|
Intercept		9.261829	< 0.0001***
Number of Children	1,2 – 3,4	-1.97201	0.0004***
Age group	2,3 – 4,5	2.260647	< 0.0001***
	2-3	-1.4139	0.0241**
Supervisory Role	1-4, 7 – 6,5	-3.54357	< 0.0001***
Ethnicity	1-6– 3	-2.2502	0.0006***
Marital Status	2 – 1	-1.34435	0.0074**
Annual Income bracket USD	4 – 5	1.845616	0.0323**
Number of children	3-4	1.148093	0.1261

** and *** denote statistical significance at 99% and 95% confidence level

2.3.1 Respondents' background

The survey was conducted on-site and in-person, and we ended up with 215 complete

survey responses from 6 out of the 9 study sites. 77% of the respondents were domestic

tourists of which 40% were between the ages of 18 and 29, while 62% of respondents

were male. The most represented ethnicity was Indo-Mauritians (people with Indian and

Pakistani ancestral lineages) at 44%, whilst the least represented were Franco-Mauritians

(locals with colonial French or British ancestral lineage) at 4% and Sino-Mauritians

(locals with Chinese ancestral lineage) at 5%. 35% of respondents had undergraduate or

graduate level education, but 46% reported not being in a supervisory position in their

workplace. 55% of respondents reported themselves as married and 56% of respondents

reported not having children. 14% of respondents reported an annual income bracket less

than USD 2,000 (lowest range), but only 6% of respondents had income between USD 50,001 and USD 150,000 (highest range). More distribution data is given in Appendix III.

For comparison, population census data for 2015 gives 14.8% of the total population aged 60 and above; 14.9% aged between 20 and 29; 15.2% aged between 30 and 39; 14% aged between 40 and 49 and between 50 and 59 (Statistics Mauritius, 2016c). 50.5% of the population were females (Statistics Mauritius, 2016c).

International tourists comprised 23% of the responses and came from countries like France, India, Saudi Arabia, South Africa, Mozambique, Madagascar and Reunion Island. The residence or point of origin for domestic respondents showed no distinctive pattern across the territory.

Mean WTP values were calculated for visitors, and segregated by domestic and international tourists at 0.95 confidence level. The mean predicted value of all respondents per visit was USD 4.77 with a 95% confidence interval of [3.97-5.58], with international tourists having higher willingness to pay mean predicted value of USD 7.73 [confidence interval 5.34-10.11], than domestic tourists with mean predicted value of USD 3.74 [confidence interval 3.11-4.36].

A summary of the inferences drawn from the regression model is shown in Table 4 below.

Table 4: Trends in willingness to pay based on regression variables

Factor	Likely to pay less	Likely to pay more
Tourism	Domestic visitors	International visitors
No. of Children	Parents of at least 1 child	Parents of ≥ 2 children
Civil Status	Married	Single
Age	50 years and above	30 to 49
	30 to 39 years	40 to 49
Job level	Any other job levels	Mid-level supervisory roles
	Highest supervisory roles	Other job levels
Ethnicity	All other ethnicities	Sino-Mauritians

2.3.2 Gender

One way ANOVA was used to test for differences in the mean WTP values between male and female respondents. Student's t-test and connecting letters report showed no significant difference across gender.

2.3.3 Tourism

International and domestic tourists showed significant difference [$F(1,148) = 20.86$, $p < 0.0001$] between their mean WTP values of USD 7.73 and USD 3.74 respectively. Mwebaze *et al.* (2010) found that international tourists (n = 286) to Seychelles had a mean WTP of €40-44 (USD 47.55-USD 52.30 at September 2017 exchange rate) on top of their existing expenses to fund conservation for the *Copsychus sechellarum* (Seychelles Magpie Robin) and sea turtles[1]. The WTP for international and national tourists are in sync with expectations, as international visitors tend to value the experience of the visit more than the national tourists, and is reflected in recent literature (e.g., Lal *et al.,* 2017) and differential pricing mechanism adopted by countries like Rwanda charging higher fees from international visitors. Similar to our findings, Tyrväinen *et al.* (2014) found that international tourists had higher WTP for forest conservation management, than domestic tourists. Tyrväinen *et al.* (2014) attributed this to tourists being more used to paying entry fees as well as having a higher purchasing power than domestic visitors. The results suggest Mauritius has much to gain by

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[1] Mwebaze *et al.* (2010) do not give the turtles' species name but there are two species known to nest in Seychelles and receive significant legal protection – the Hawksbill turtle (*Eretmochelys imbricata*) and the Green turtle (*Chelonia mydas*).

maximizing marketing of nature-based tourism to international markets, however, managers should also investigate the ideal tourism carrying capacity of their sites.

We compared our findings with those published in the 2017-2020 Black River Gorges Management Plan. This management plan, published by the NPCS, reports interviewing 184 visitors in 2014, of which 41.8% were Mauritians, 51.7% were foreigners. The report refers a separate study report that should provide details of the survey methodology (length of data collection period, whether data was collected at Upper or Lower Black River Gorges or both entry points, whether the data was collected in peak or off-peak tourist season, how the sample was randomized and how the WTP bid values were estimated), but this report is not available online, and has not been made available by the NPCS. The report also states 53.2% of Mauritians would not be willing to pay a "small" entry fee, but 18.9% of international visitors would be willing to pay about USD 3.71 (December 2017 exchange rate 1 USD = MUR 33.70). There is no information on how the "small" entry fee is defined monetarily, now how the means by which the WTP of USD 3.71 was derived (open ended WTP question, bidding system, payment card system or otherwise). They also report a 2016 survey of 117 international visitors reporting that 26.5% were willing to pay a fee between USD 1.51 and USD 2.97 while 18% were willing to pay between USD 4.48 and USD 5.93. The depth of information on this study's methods, assumptions made, justifications and analysis is also lacking and therefore hard to accurately compare.

2.3.4 Number of children, Marital Status

Results suggest statistically significant negative parameter estimate for "Number of children" and show that people with one child or less tend to have lower WTP than people with at least two children. Alvarez and Larkin (2010) found that park visitors with children had a higher WTP than those with no children; results which the authors associated with the value placed on natural resources for future generations. However, parents with one child or less, may be weighing their WTP against their income and family needs. The significant negative parameter estimate for marital status suggests that married people tend to have a lower WTP value than single people, possibly associated to weighing the costs of a family outing, as opposed to individual costs of visiting a site.

2.3.5 Age

Results suggest that visitors aged between 30 to 49 have a higher WTP value than visitors aged 50 and above. Results also show that visitors' aged 30 to 39, tend to have a lower WTP value than those in 40-49 age group. In comparison, Alvarez and Larkin (2010) found that people younger than 40 were likely to have higher WTP values and associated this trend to greater pro-environment attitudes in younger age groups. They also found that older visitors tend to have a lower WTP value, linked to skepticism about park transparency in the use of funds. Currently, almost all public and private service providers in the country provide discounts of up to 50% for senior citizens (aged 60 and above). Our study results also reinforce the fact that maintaining such a policy on entry

fees to benefit visitors aged 60 and above to state and private forest sites has a positive effect on WTP.

2.3.6 Supervisory role

The regression model indicated that people with mid-level supervisory positions (supervising "a major division of an agency or department" or supervising "an entire agency or department) tend to have higher WTP value than other supervisory categories. Contrary to expectations, study results suggest that respondents in highest job positions tend to have lower WTP vis a vis their counterparts. Lower WTP values for the respondents who do not supervise others or are in low-level supervisory positions can be attributed to their lower income status.

2.3.7 Ethnicity

Results show that all ethnic groups, except Sino-Mauritians, tend to have a lower WTP value. Based on direct observation of visitor behavior, that differences in WTP values between ethnicities could be explained by the social context of their visits to a site. The distribution of "purpose of visit" by ethnicity highlighted that Sino-Mauritians favored socialization by 64% compared to other ethnic groups, and this may explain their willingness to pay more to keep having access and enjoying the site. 78% of Franco-Mauritians surveyed were actively training for the 2015 Indian Ocean Island Games and other marathons. Training gear and participation costs, as well as frequency of training, could explain their lower WTP. 59% of Indo-Mauritians and 52% of Creoles favored family and friend gatherings as a reason to visit a forested area, but outlines that they

intended to finish their trips at the beach rather than at the site itself, suggesting that their total expenses might influence their WTP towards lower values.

Larson *et al.* (2014), in a study preferences of visitors (n = 1,073) to Georgia state parks in the United States, found that visitors belonging to minority groups and who are low income earners highly preferred "being active with family and friends" and preferred participation in activities that involved their relatives and friends. Alvarez and Larkin (2010) found that visitors' interest to be part of a group could lead to a higher WTP for restoration. They also outline that visitors that were part of bus tours could perceive entry fees as unrecoverable costs associated to the package already paid for. Similar to Larson *et al.* (2014) suggestions, managers of natural areas in Mauritius (state and privately owned) can create lower entry fee packages for repeat visitors, or seasonal passes to cater for differences in income ability and activity preferences. In high visitor season, multiple trips may be detrimental to encouraging visitors, if they have to pay entry fees or levies at all sites. Entry fees for large families or groups can be perceived unfavorably. Weekly entry fees may also become a budgetary burden to regular trail runners. An inflexible entry fee system may be appealing in administrative simplicity but might result in unintentional tradeoffs in terms of lowering visitor numbers. The variety of ways and means of applying an entry fee system to forested areas is given in Section 5.2.

2.3.8 Annual household income

Study results suggest that people with annual incomes between USD 12,000 and USD 18,000 are significantly more likely to have a positive WTP. Alvarez and Larkin (2010) found that higher income earners are likely to spend more on nature-based tourism and conservation. Our results suggest that the income impact was not statistically significant. One explanation may be similar to the findings of Kamri (2013) who suggests that high income earners may feel that they are already making their contribution to conservation funding through their income tax.

2.3.9 Zero payment respondents

30% of respondents, in our study, were not willing to pay an entry fee or any extra amount on existing entry fees. Of these, 85% were domestic tourists and 15% were international tourists. Table 5 below shows the proportion of visitors who identified reasons for their choice, from a given list. As shown by the list, the two main arguments favored by visitors dealt with the perceived lack of transparency when it comes to allocating funds to conservation, and the sense that Government should have a bigger share of responsibility.

Table 5. Reasons provided by respondents who are not willing to pay for conservation in the form of entry fees or a levy.

Answer options to question: "*If you are not willing to pay an entry fee, please tell us why.*"	Domestic tourists	International tourists
I don't believe that the funds will go to conservation of the park.	35%	10%
The entry fee is already expensive for me.	8%	-
I do not have the financial capability to invest in conservation or pay any entry fee	15%	10%
I do not care for biodiversity issues	7%	-
The government should pay.	48%	50%
Only big corporations should pay.	26%	20%
I do not think our forests and biodiversity are at risk.	2%	-
The benefits are too distant/I don't care for future generations.	-	-
I don't have enough information about the threats to forests and the conservation measures.	-	-

Some respondents provided additional arguments for not wanting to pay an entry fee or levy, arguing that these would discourage low-income visitors. They suggested having donation boxes at the sites, rather than making additional fees/levy mandatory. Some of the respondents suggested that forestlands are a public good and should therefore remain free. Some others argued that conservation would come with investment in better education and sensitization on respecting nature. Some respondents, particularly at Government managed sites, said that the site offered poor facilities in terms of inadequate bathrooms, intermittent water supply, absence of garbage collection and/or garbage bins, absence of adequate security for visitors' vehicles and property, and are not willing to pay any amount. These findings are similar to the work of Lee *et al.* (2010) who showed that enjoyment of natural areas increases with provision of facilities like tables, toilets, parking space and educational signs. From a policy perspective, improving visitor satisfaction, especially at state-managed sites, could generate greater acceptance of an entry fee.

2.3.10 Revenue Analysis

Taking into account the upper and lower bounds of per hectare costs reported in Mauremootoo (2017), the estimated per hectare costs of restoring different extent of native forests are shown in Table 6 below. The areas represented are estimates and based off of data from the NBSAP (2006), the Protected Area Network project (UNDP-GEF, 2009), Paupiah (2001) and the Aichi Biodiversity Targets of the Convention on Biological Diversity (CBD) (Secretariat of the CBD, 2010). A decrease in costs significantly alters the total amount that would need to be raised for each of the coverage

targets shown. For example, restoring the full extent of mountain and river reserves, without fencing, would require between USD 16 million and USD 33 million, disregarding the time factor. The estimates shown in Table 6 may include marginal lands, heavily degraded forest lands and coastal forests.

Table 6. Estimated costs in million USD (rounded to nearest whole number) for restoration, segregated by documented targets and coverage.

Target for restoration	Area in hectares (ha)	Total projected costs based on Government reports			Total projected costs based on Florens et al (2010) and Florens and Baider (2013)	
		Fencing + Weeding		Weeding only	Weeding	
		USD 16,064 per ha (lower bound)	USD 20,883 per ha (upper bound)	USD 5000 per ha	USD 2,400 per ha (lower bound)	USD 3,100 per ha (upper bound)
NBSAP (2006) target	**1,000**	16	21	5	2	3
Protected Area	**14,920**	240	312	75	36	46

network project target					
Aichi CBD target	**5,000**	80	104	25	12	16
National Parks only	**7,026**	113	147	35	17	22
Nature Reserves only	**200.26**	3	4	1	0.48	0.62
Mountain and River reserves only	**6,553**	105	137	33	16	20
Privately owned native forestland (excl. mountain and river reserves)	**27,567**	443	576	138	66	85
State owned native forest land (excl. protected areas)	**15,292**	246	319	76	37	47

The dearth of visitor number data makes it difficult to estimate funds that could be raised at individual sites. We therefore calculated the revenue potential of targeting 10%, 25%, 50%, 75% and 100% of total adult (aged 20 and above) domestic population and international tourists using 2015 census data. The population breakdown by age group is given in Table 7. To estimate conservation finance (in USD) that can be raised at any one site, we used mean WTP values and lowest and highest CI values, multiplied by targeted sections of residents and tourists aged 20 and above. The estimated revenues are shown in Table 8. We assumed a visitor only went to a single site per year. In practice, a visitor might go to multiple sites on both state and privately owned lands in a period of a year or visit the same site multiple times. We anticipate that funds collected at state-owned sites will be centralized by the lead state agencies prior to future disbursement, whilst privately owned sites have greater flexibility of using funds they individually raise.

Table 7. Distribution of resident population and tourist arrivals to Mauritius by age group. Data compiled from Statistics Mauritius 2014, 2016b and 2016c.

Age group	2015 estimated resident population based on 2011 census data	2015 tourist arrivals
0-19	345,105	178,473
20-29	188,048	195,478
30-39	191,651	225,811
40-49	175,576	206,126
50-59	175,814	185,496
60 and above	186,411	159,868
Total population	1,262,605	1,151,723
Total aged 20 and above	917,500	972,779

Table 8. Estimated revenues (in million USD) that can be raised for conservation using mean WTP values and lowest and highest CI values.

	Target percentage of people aged 20 and above	Using lowest CI value of 3.11 USD	Using all visitors' mean of 4.77 USD	Using domestic mean of 3.74 USD	Using international mean of 7.73 USD	Using upper CI of 10.11 USD
Domestic tourists	10%	0.29	0.44	0.34		0.93
	25%	0.71	1.09	0.86		2.32
	50%	1.43	2.19	1.72		4.64
	75%	2.14	3.28	2.57		6.96
	100%	2.85	4.38	3.43		9.28
International tourists	10%	0.30	0.46		1.92	0.98
	25%	0.76	1.16		4.81	2.46
	50%	1.51	2.32		9.61	4.92
	75%	2.27	3.48		14.42	7.38
	100%	3.03	4.64		19.22	9.83

Estimates suggest that if a minimum of 10% of the resident adult population each paid USD 3.11 towards conservation, this could bring USD 290,000 in a year to a site for forest restoration. Assuming costs of USD 3,100 per hectare, 93.5 hectares could be cleared of invasive species in a year at any one site. If 10% of residents and 10% of all tourist arrivals visited any one site and paid the mean WTPs of USD 3.74 and USD 7.73 respectively, at least 729 hectares could be cleared in a year at costs of USD 3,100 per hectare. If state agencies use state-reported restoration costs of USD 20,883 per hectare, with 10% of residents and 10% of all tourist arrivals paying the mean WTP of USD 4.77, this could result in about 43 hectares restored and fenced per year. Even our most conservative estimates suggest that there is significant ecological and economic gain to be made by using entry fees as a means to raise revenue for forest conservation on the island. On a yearly basis, entry fees can result in more consistent restoration programs being funded and carried out.

Our studies contrast with the 2017-2020 Black River Gorges Management Plan which reports that the park can generate about USD 949.44 (December 2017 exchange rate of 1 USD = MUR 33.70) every day using visitor counts for the month of June 2016 and by charging only international visitors an entry fee of USD 2.97 per person. As explained earlier, the management plan does not provide details of the surveys nor the methodology used to establish the bid values. Nonetheless, our lower CI for the international visitors' WTP value exceeds the WTP reported in the management plan by USD 2.37, suggesting that state agencies may be foregoing on a much larger revenue stream from international

visitors, and therefore compromising the extent of restoration that can be successfully and sustainably financed.

Mwebaze *et al.* (2010) report costs between USD 3,100 and USD 50,220 for invasive species management planning; between USD 10,300 and USD 50,220 for eradication, and long terms monitoring costs between USD 15,000 and USD 40,000 per year. In the case of Seychelles invasive species eradication and management considered insect and animal invasive species, as well as prevention measures like border inspections. Insect and pest control in Mauritius is limited to agricultural pests and reporting on costs is not within the purview of the NPCS and FS, such that the restoration costs we report pertain principally to weeding of long-established alien plant species from forest lands.

To conclude, our findings indicate that there exists a positive WTP from both international and domestic tourists. We also validated the current practice of charging differential entry fees for domestic and international visitors and showed that privately-owned sites can potentially increase their entry fees, on the principle that the extra amount will be directed to forest conservation and restoration. Costs of invasive species removal increase with plot size. Forested sites vary in their land extent and geomorphology, making it difficult to predict how long private and public forestland managers may take to fully complete restoration. The slope of the land, the degree of risk perceived by laborers, contractor rates, and market inflation rates also influence costs. Nonetheless, entry fees offer a viable mechanism of building a sustainable revenue stream for forest conservation.

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3 RECREATION DEMAND AND ECONOMIC VALUE OF NATIVE FOREST LANDS

3.1 Introduction

Combining shifts in economic trends and the growing need to preserve and protect declining natural resources, tourism has become a go-to conservation strategy to generate revenue and awareness (Wunder, 1999). Many small island states have been able to turn their insularity, tropical climate, culture, exoticism, unique flora and fauna into viable assets for the tourism sector (Wortman *et al.,* 2016). Pressures and demands from tourists generally drive local companies towards innovative and competitive tourist services (Van den Bulcke *et al.,* 2009). Growth of nature-based tourism as a product for international markets is often paralleled by the interest of residents to become domestic tourists themselves and explore the same products and services offered to international visitors. At the same time, conservation of forest land has been spurred given the economic potential of this industry (Balmford *et al.,* 2009). Canavan's (2013) study showed that residents of the Isle of Man favored internal tourism to break-away from routine, entertain friends and family and explore new places. Outdoor recreation and nature-based tourism can be quantified using economic methods.

Mauritius has not escaped the global nature tourism industry. Various sites across the island offer opportunities for scenic non-commercial outdoor recreation like jogging as well as commercial activities like guided hikes, quad biking and mountain climbing. Sites that offer a variety of such activities are on both state and privately owned forest lands. In 2009, a project funded by the United Nations Development Program-Global

Environment Facility (UNDP-GEF) aimed at assessing the creation and management of a protected area network in Mauritius, used a one-time visitor count to the Black River Gorges National Park to estimate a recreation value of MUR 29.8 million (about USD 880,000) for the park. Our study improves this valuation by providing an estimate of recreation value of forested areas across the island.

3.2 Methodology

3.2.1 Survey design

The travel cost survey instrument consisted of four sections. The first section was an introductory script explaining the purpose of the study in helping researchers determine the value attached to forests by users. The second section consisted of questions that enquired about visitors' existing knowledge on and attitudes to conservation issues. Respondents were asked to rate statements (A1 to A8), given in Table 1, in terms of "Strongly Disagree" to "Strongly Agree". The third section elicited visitors' travelling expenses and habits. The survey reminded respondents to provide answers relating to the amounts they individually spent on the trip, whether in their entirety for their group or family, or their portion only. In this section we enquired about respondents' residency, local transport costs from their home to site associated to travelling by hired bus, hired van or public bus (LTRC), food costs incurred en route or on site (FOODC), their frequency of visits to a site (FREQV), entry/activity fees incurred at the site (ENTC), mode of transport to a site, whether they were alone or as part of a group and group size, point of origin and whether other sites were planned for the day. We also enquired about

the main purpose (P1 to P4) of respondents' visit to a site. The last section of the survey

enquired about respondents' socio-demographic background, with the different levels

shown in Table 9. The survey instrument was pre-tested and refined in

comprehensiveness by local experts in nature-based tourism and forest management. The

survey was administered in English, French and Mauritian Creole.

Table 9: Description of attitude and socio-demographic variables from the TCM survey.

Variable	Type		Partition
Age Group	Ordinal	1: 18-29	1: {1,2}
		2: 30-39	
		3: 40-49	
		4: 50-59	
		5: Above 60	
Gender	Nominal	1: Male 2: Female	-
Ethnicity	Nominal	1: Franco-Mauritian	-
		2: Indo-Mauritian	
		3: Sino-Mauritian	
		4: Asian-born resident	
		5: Overseas-born Caucasian resident	
		6: Creole	
Marital status	Nominal	1: Single	-
		2: Married	

		3: Divorced/Separated	
		4: Partnership	
		5: Widowed	
Highest level of schooling completed.	Nominal	1: Certificate of Primary Education	1: {1,2}
		2: School Certificate	2: {3,4,5}
		3: Higher School Certificate /Baccalaureate	
		4: Trade/technical/vocational diploma	
		5: Bachelor's degree	
		6: Masters degree	
		7: Doctoral degree	
Supervisory role	Ordinal	1: I do not supervise	1: {1,2,3}
		2: I am the lead worker in my unit	2: {4,5,6}
		3: I supervise a single unit of employees	
		4: I supervise two or more units, each unit having an individual supervisor	
		5: I supervise a major division of an agency or department	
		6: I supervise an entire agency or department	
		7: I supervise more than one agency or department	
Number of Children	Nominal	1: None 2: 1 3: 2 4: More than 2	-

Annual Income Bracket (USD)	Ordinal	1: Less than or equal to 2000 2: 2001 to 5000 3: 5001 to 12000 4: 12001 to 18000 5: 18001 to 30000 6: 30001 to 50000 7: 50001 to 100000 8: 100000 to 150000			1: {1,2} 2: {3,4,5 ,6,7,8}
A1: Forests in Mauritius are well protected	Ordinal	1 : SD 4: A	2: D 5: SA	3: N	1: {1} 2: {2,3,4,5}
A2: Native species are at risk of extinction	Ordinal	1 : SD 4: A	2: D 5: SA	3: N	1: {1,2,3,4} 2: {5}
A3: Only professionals should decide how the park should be managed.	Ordinal	1 : SD 4: A	2: D 5: SA	3: N	1: {1,2,3,4} 2: {5}

Variable	Type				Partition
A4: I am well informed about biodiversity loss in Mauritius	Ordinal	1 : SD 4: A	2: D 5: SA	3: N	1: {1,2,3,4} 2: {5}
A5: I always consider the environmental quality of site before visiting	Ordinal	1 : SD 4: A	2: D 5: SA	3: N	1: {1,2,3,4} 2: {5}
A6: Conservation of biodiversity is a moral obligation.	Ordinal	1 : SD 4: A	2: D 5: SA	3: N	1: {1,2,3,4} 2: {5}
A7: Biodiversity loss will affect the country's economy.	Ordinal	1 : SD 4: A	2: D 5: SA	3: N	1: {1,2,3,4} 2: {5}
A8: Biodiversity is essential for	Ordinal	1 : SD	2: D	3: N	1: {1,2,3,4}

production of goods and medicine.		4: A	5: SA	2: {5}
P1: Sports and Fitness	Nominal	1: No	2: Yes	
P2: Enjoy nature and outdoors	Nominal	1: No	2: Yes	
P3: Socialize with friends and family	Nominal	1: No	2: Yes	
P4: Reduce stress	Nominal	1: No	2: Yes	

Notes: SD 'Strongly Disagree', D 'Disagree', N 'Neutral', A 'Agree', SA 'Strongly

Agree'.

3.2.2 Data Collection

We surveyed every fifth domestic visitor to forested sites across mainland Mauritius. State owned and state managed forested sites surveyed were Upper Black River Gorges National Park (Pétrin – Site 2 in Fig.6), Lower Black River Gorges National Park (Black River – Site 3), Bras d'Eau National Park (Site 6) and Le Pouce Nature Reserve (Site 5). No entry or activity fees are charged by the state at these sites. We also surveyed visitors to Trou aux Cerfs (Site 4), a publicly-accessible dormant volcano with well-preserved vegetation, surrounded by urbanization and popular with joggers and scenic viewers. Privately owned and managed forested sites we surveyed were La Vallée des 23 Couleurs (Site 1), La Vallée de Ferney Forest and Wildlife Reserve (Site 8) and Le Domaine de L'Etoile (Site 7), all of which offer various paid outdoor recreation activities. Lastly, we surveyed visitors to Ile aux Aigrettes (Site 9), a fully-restored islet managed by the non-profit Mauritius Wildlife Foundation and which offers paid nature-tourism tours. Surveys were conducted between 2nd May and 23rd August 2015 with the majority of responses recorded during weekends because of the higher number of weekend visitors. Given our objective was to assess the overall value of accessing forested areas across Mauritius, our study considered the island as a 'single-site', combining survey-based data from nine sites.
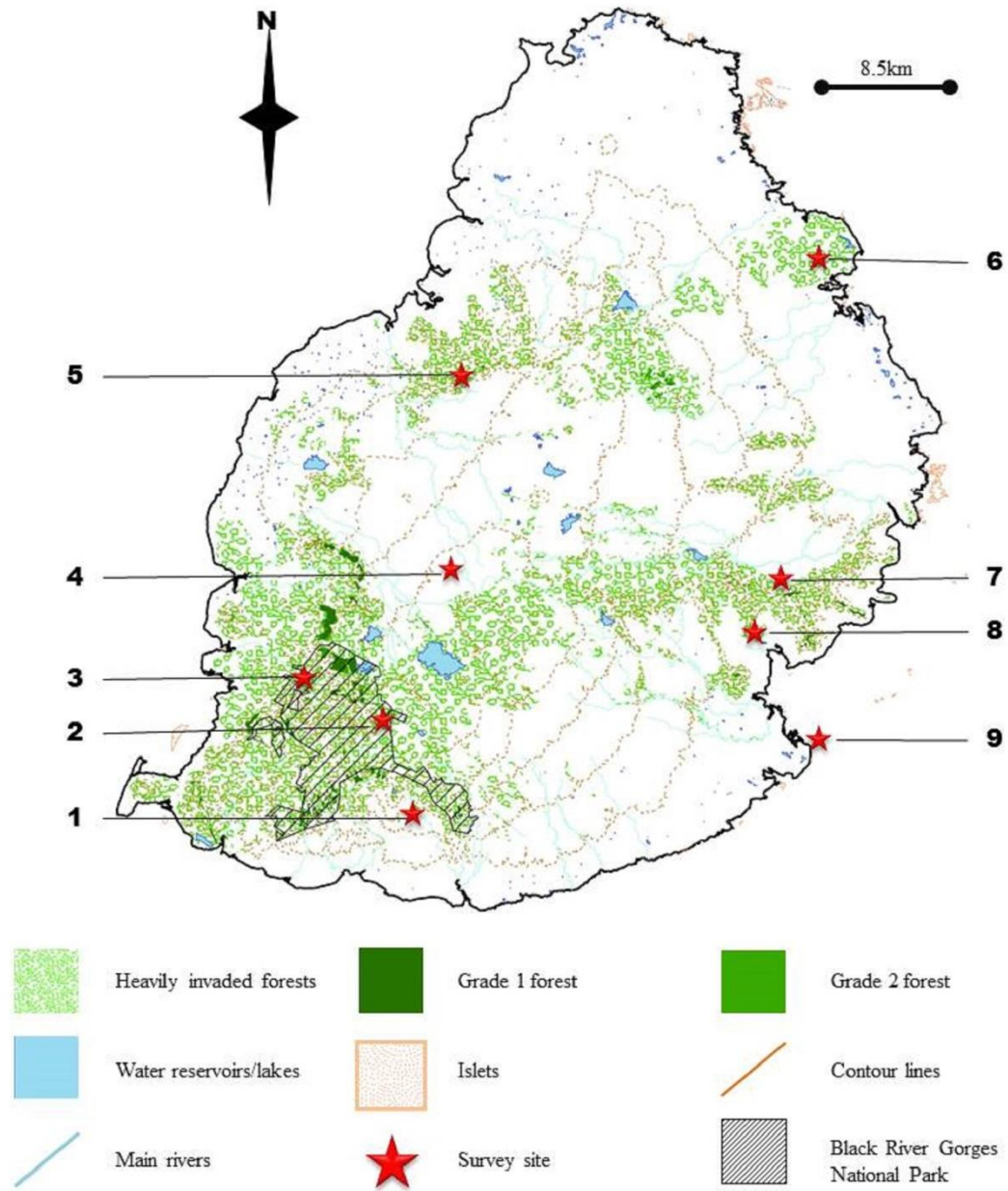
Figure 6: Illustrative map of Mauritius showing approximate locations of sites where TCM surveys were conducted.

3.2.3 Theoretical Specification

In assessing the demand for recreation, maximum utility becomes a function of costs

involved (i.e. travel costs (*tc*)), number of visits (*v*) to a recreation site and its

environmental quality (*a*), as shown below:

$$\max u \; (tc, \, v, \, a)$$

In TCM, trip frequency is treated as a function of costs incurred and individual

characteristics of the park user, as shown in the equation below;

$$V_i = f \; (TC_i, Z_i, A_i, \mathcal{E})$$

where V_i is the frequency of visits to a park by user *i*, TC_i is the total travel cost incurred

by user *i*, Z_i is the set of socio-demographic characteristics that define user *i*, A_i is the set

of attitudes of user *i* to environmental topics and ε is the independent, randomly

distributed error term for unobserved factors. From a utility perspective, the maximum

benefit for a visitor can be capped by a maximum travel cost, beyond which visit

frequency declines. With count data like visit frequency, the typical approach is to use a

Poisson distribution with equal mean and variance to represent the probability of user *i*

taking V trips, as shown below.

$$P \; (V_i) = \frac{e^{-\lambda}.\lambda^V}{V!}$$

where λ is the mean and variance of the expected number of trips and follows the demand

function:

$$\lambda = e^{\beta(TC+Z+A)}$$

$$\ln(\lambda) = \beta TC_i + \beta Z_i + \beta A_i$$

The Poisson model relies on equal mean and variance of V. In many cases of visit frequency data however, there can exist more observed variance than expected, resulting in over-dispersion. This can be adjusted for by using a negative binomial regression where the variance is a function of the mean and the regression output includes a dispersion parameter (Greene, 2008). The probability of an observed visitor frequency v_i can be given by:

$$P\,(V = \, v_i|\mu_i, \alpha) = \frac{\Gamma\,(v_i + \alpha^{-1})}{\Gamma(\alpha^{-1})\Gamma(v_i + 1)} \left(\frac{1}{1 + \alpha\mu_i}\right)^{\alpha^{-1}} \left(\frac{\alpha\mu_i}{1 + \alpha\mu_i}\right)^{v_i}$$

where Γ represents the gamma function. The negative binomial regression will have mean λ and variance $\lambda(1 + \alpha\lambda)$ and the parameter estimates can be derived using maximum likelihood (Greene, 2008).

3.2.4 Analysis

Similar to Benson *et al.* (2013), our study targeted visitors directly at forested sites on the island, such that those whom were not there on survey dates, would have a default trip frequency of zero. We adapted the method of Bartczak *et al.* (2012) by asking respondents to report the frequency of their visits to the park over a typical year (FREQV) in terms of "Once a year", "Once a month", "Several times a week" (taken as 3 times a week), "Once a week" or "Once a day". These categorical variables were converted to discrete values "1", "12", "156", "52" and "365" respectively.

The travel costs for each respondent comprised of how much they spent on transportation, fuel, food, entry fees (if applicable) and the opportunity cost of their travel and leisure time. All money amounts were in Mauritian Rupee but converted to US dollars in this chapter at August 2015 (end of study) prevalent rate of 0.03478 (Bank of Mauritius, 2016).

Potential opportunity costs associated to the time (TIMEC) visitors took to travel to the site (TRTMC), and the time they spent at the site (STTMC) was calculated as follows:

$$TIMEC_i = TRTMC_i \text{ (Wage rate USD/hr)} + STTMC_i \text{ (Wage rate USD/hr)}$$

The average wage rate for Mauritius was obtained from the International Labor Organization's ILOSTAT database and given at MUR 568/month (USD 3.28/hour). For the purposes of this study, we assumed adult visitors are all employed full time, working 40 hours a week, 52 weeks a year. Cesario (1976) used evidence from transportation research to warrant the use of one-third of the wage rate in recreation demand valuation. The main argument for using a third of the wage rate is the lower perception of value attached to leisure time, compared to working time. On the other hand, using the full wage rate provides a more accurate valuation of the opportunity cost of the time. Adapting the method of Benson *et al.* (2013), we used the full wage rate and a third of the wage rate to assess the sensitivity of the travel cost analysis.

Respondents were asked their mode of travel to the site, their point of origin and any other sites included in their trip. We used Google Maps™ road mapping to establish two-way distance covered by respondents (DIST). Domestic visitors travelled using

either their private cars, public bus or by booking a multi-passenger transport if they were

travelling as part of a large group. We assumed that the transport costs paid to book a

multi-passenger van or bus for group visits, included the costs of fuel. We used the 2014

fuel economy rate of 5.8L/100km reported for Mauritius by the Global Fuel Economy

Initiative (2016) and the gasoline retail price of MUR 45.95 (USD 1.60) per liter reported

for August 2015 by the Mauritian Petroleum Pricing Committee (State Trading

Corporation, 2014), to estimate the cost of fuel (FUELC) incurred by visitors using

private cars, using the following formula.

$$FUELC = DIST \text{ km x } 0.058 \text{ L/km x } 1.60 \text{ USD/L}$$

All statistical analyses were performed using SAS JMP® Pro v.13.2 software. We used

the partitioning function to split attitude, purpose and some socio-demographic

observations (see Table 9) into similar groupings, which were then assigned dummy

categorical variables. This allowed for a more robust regression analysis by taking into

account thresholds of observations, as opposed to multiple levels.

With all variables accounted for, we defined two TTRCs as follows:

$$TTRC_{FW} = LTRC_i + FOODC_i + FUELC_i + TIMEC_i + ENTC_i \text{ , using the full wage rate.}$$

$$TTRC_{W/3} = LTRC_i + FOODC_i + FUELC_i + TIMEC_i + ENTC_i \text{ , using a third of the wage}$$
$$\text{rate.}$$

We used the mixed stepwise approach to come up with a robust subset of variables to be

picked up by the regression models, following an iterative optimization process. This

iterative process computes the squared t-statistic for each variable, giving it as a F-statistic. A variable with high enough F statistic is kept whilst a low-enough one gets rejected from the model (Warner, 2008). The mixed stepwise regression is preferred for its flexibility; as variables get added to the model, any variable that has a p-value above the probability-to-leave threshold, is automatically removed.

With the set of variables identified by the stepwise method, Poisson and negative binomial regressions were used to model FREQV. The Poisson output gave the deviance statistic, which when divided by the degrees of freedom, gave an over-dispersion parameter of 84 and 203 for models with $TTRC_{FW}$ and $TTRC_{W/3}$ respectively. The Poisson models using $TTRC_{FW}$ and $TTRC_{W/3}$ both had highly significant p-values for the goodness of fit statistic, thereby rejecting the null hypothesis that the model is a good fit. The negative binomial model was therefore favored and reported upon.

3.2.5 Consumer Surplus and Recreation Value

We used the same method as Alvarez and Larkin (2010) to estimate the residents' consumer surplus for forested areas in Mauritius.

$$CS = \int_{TTRC_{\mu}}^{TTRC_{max}} (\beta_0 + \beta_1 TTRC) \, dTTRC$$

where CS is the consumer surplus, β_0 is the intercept of the demand function, β_1 is the estimate for the TTRC and $TTRC_{\mu}$ is the mean TTRC. Our study solved for two travel cost means (Table 10), two intercepts and two coefficients (Table 11), therefore generating two consumer surplus estimates. Given the absence of annual visitor counts

from the sites included in this study, we estimated the recreational value of forested areas by multiplying our CS estimates with target percentages of the Mauritian adult population (as per census data, aged 20 and above) of 917,500 (Statistics Mauritius, 2016).

3.3 Results and Discussion

3.3.1 Respondents' background

Our data collection resulted in 188 complete responses across nine study sites. 21% of respondents were aged between 18 and 29 (Statistics Mauritius (2016) has 15% of the population in that age group); 31% of respondents were aged 30 to 39 years (15% of the population); 20% aged 40 to 49 (14% of population); 17% aged 50 to 59 and 12% aged 60 and above (14% and 15% of the population respectively). 62% of respondents were male (Statistics Mauritius (2016) has 50% of population as males). 48% were of Indo-Mauritian ethnicity (i.e. born with Indian/Pakistani ancestral lineage). 67% were married and 54% reported being parents to maximum one child. 32% reported having studied up to higher education and 51% reported not being in any supervisory position. 39% reported earning between USD 2000 and USD 5000 per year. 21% were visiting as a couple, 51% as a group of family and/or friends and 26% were visiting by themselves. On average, our findings suggest residents visit forested-areas across the island 39 times a year, with a 95% confidence interval [29-49 days]. Additional distribution data is given in Appendix V.

3.3.2 Travel Cost

Our computation of time costs used the time respondents reported they took to travel from their home to the site, similar to approach followed by Czajkowski *et al.* (2015). They argued that this approach caters for differences in respondents' preferences for alternate routes, or any stops on the way e.g. to pick up friends and family, or buy food. Only 20% of respondents reported ending their trips at a beach or picnic area on their way back home. Given the forest site had priority in respondents' plans, we did not consider side trips to the beach or other rest areas as significantly impacting respondents' main purpose for visiting a forested site. Table 10 gives an overview of the summary statistics for the total travel costs.

Table 10: Summary statistics for total travel costs, fuel costs and round-trip distance covered.

	Mean	Standard Dev	Lower CI	Upper CI	Max
$TTRC_{FW}$	31.20543	58.40621	22.80216	39.60869	526.3138
$TTRC_{W/3}$	22.7989	57.45609	14.53234	31.06547	519.7599
FUELC	4.383547	3.24014	3.836111	4.930983	
DIST/km	46.40957	33.47799	41.59289	51.22626	

3.3.3 Model Output

The model accepted the null hypothesis that the model is a good fit based on p-value.

The regression output is given in Table 10.

Table 11. Variables that can predict the frequency of visits to forested areas, using

$TTRC_{FW}$ and $TTRC_{W/3}$.

	with $TTRC_{FW}$			with $TTRC_{W/3}$		
Term	Estimate	Std. Error	p-value	Estimate	Std. Error	p-value
Intercept	5.751711	0.587466	<.0001***	5.682741	0.584514	<.0001***
TTRC	-0.00981	0.004068	0.0159*	-0.01043	0.004309	0.0155*
Gender [1-2]	1.157588	0.346686	0.0008**	1.168809	0.343755	0.0007**
Ethnicity{2,3,5,6-1,4}	-0.27332	0.241988	0.2587	-0.27383	0.24131	0.2565
Marital status{1,2, 3-4,5}	-0.44716	0.496649	0.3679	-0.47387	0.495432	0.3388
Marital status{2&1 -3}	-0.65383	0.465941	0.1605	-0.64898	0.463045	0.161
Marital	-0.10604	0.93464	0.9097	-0.12105	0.93328	0.8968

status{4-5}						
Education						
Partition [1-2] A2	-0.26161	0.320137	0.4138	-0.2795	0.318653	0.3804
Partition [1-2] A3	-0.80675	0.293793	0.006**	-0.81468	0.291317	0.005**
Partition [1-2] A4	-0.64743	0.315981	0.0405*	-0.61885	0.314657	0.0492*
Partition [1-2]	-0.97704	0.317589	0.0021**	-0.97527	0.316073	0.002**
Sports, Exercise and Fitness [1-2]	-0.4856	0.319039	0.128	-0.48703	0.318545	0.1263
Dispersion	2.034639	0.223545	<.0001	2.027835	0.223319	<.0001
Loglikelihood	-506.934			-506.757		
Sample size	188			188		

| Generalize d RSquare | 0.38845 | 0.390093 |

*, ** and *** denote significance levels of 0.05, 0.01 and 0.001 respectively

Our TTRC estimates at full and a third wage rate came out as negative with 99% significant p-values, a relationship which is in line with travel cost studies in published literature. From our models, if visitors' travel costs increase by USD 1.00, their log of visit frequency decreases by 0.01 (2 days per year) whether the wage rate is used in full or a third.

3.3.4 Socio-Demographics

Our results suggest that men are likely to have higher visit frequencies than women. Additionally, 62% of male respondents reported visiting a site as part of a group of family and/or friends. Trend towards higher visit frequencies may be explained by preference for peer activities or by the role of men in the family unit. Filiatrault and Ritchie (1980) argued that in a typical household with children, the decision-making process is dominated by husbands. In their study of in-state travel for residents of Arizona, Nyaupane and Andereck (2008) showed that women experience more cost constraints than men. Blin (2008) showed that women in Mauritius feel a significant share of costs associated to purchase of books, uniforms, private tuition and other educational needs of their children. This suggests that women may be more likely than men to weigh costs of leisure trips against family needs - especially educational costs of children – and therefore opt for less frequent visits, compared to men.

Ethnicity, marital status and education were not identified by our regressions as significant variables. Income was also not picked up as a variable of interest by the stepwise process. With regards to potential effects of income, it is important to acknowledge that in the coming years, recognition of greater management costs are likely to shift policies towards implementation of entry fees at sites that are currently free. This may become an impediment to frequent visits to forested areas by low-income residents. Blaine *et al.* (2015) cite a body of literature that report zero to negative relationship between income and visitation rate, suggesting that low-income visitors may have fewer options to choose from as compared to higher income earners. They also suggest that choices for low-income earners may dwindle further as more and more publicly accessible sites follow private development trends and adopt restrictive access policies.

3.3.5 Attitudes to Conservation

Respondents who "strongly disagreed" to "agreed" with the statement that native species in Mauritius are at risk of extinction, were more likely to have fewer visits per year to a forested area, compared to those whom strongly agreed with the statement. Similarly, respondents who "strongly disagreed" to "agreed" with the statement that they are well-informed about conservation issues in Mauritius, were likely to have a lower visit frequency that those whom "strongly agreed". Lastly, respondents who "strongly disagreed" to "agreed" with the statement that only professionals should be involved in forest management, were likely to have an annual visit frequency lower than those whom strongly agreed with the statement. Canavan (2013) argued that having a sense of ownership could be a factor in maintaining a strong domestic tourism industry. He

highlighted this could manifest in the form of residents' interest in their surrounding environment and their motivation to explore. With that in mind, we suggest that respondents may have associated the statement "Only professionals should decide how the park should be managed" with possible restrictions on access to forested areas by land owners and/or the state, explaining the significant trend towards lower visit rates.

3.3.6 Consumer Surplus

Per person, the CS is USD 3,975.54 per year when using the full wage rate, and USD 3,739.21 per year when using a third of the wage rate. The recreation value of forested areas, shown in Table 12, can be estimated by multiplying the CS with target percentages of the Mauritian population aged 20 and above, as a proxy for the annual number of visitors to forested areas.

Table 12: Annual recreation value in USD, calculated using $TTRC_{FW}$ and $TTRC_{W/3}$

Target Resident Population	Annul Recreation Value USD (full wage)	Annual Recreation Value USD (third of wage)
10 % = 91,750	261,723,298	259,584,605
25 % = 229,375	654,308,244	648,961,513
50 % = 458,750	1,308,616,488	1,297,923,025
75 % = 688,125	1,962,924,731	1,946,884,538
100 % = 917,500	2,617,232,975	2,595,846,050

The total recreation value estimates shown in Table 12 are conservative estimates. Our survey data was acquired during a low-visitor season, given that the majority of domestic tourists favor long summer school holidays for their leisure activities. The Strategic Plan 2016-2020 for the Food Crop, Livestock and Forestry Sectors (Ministry of Agro-Industry and Food Security, 2016) reports budgeting MUR 56.4 million (USD 1.7 million) to the forestry sector for the period 2017/18 and MUR 50.15 million (USD 1.5 million) for the period 2018/19. Coupled with the popularity of the sites with international tourists the surplus value of forested areas in Mauritius exceeds the annual state budget put aside for their conservation, as has been recognized by Alvarez and Larkin (2010) for parks in Colombia. The recreation value of MUR 29.8 million (about USD 880,000) reported by the UNDP-GEF (2009) for the Black River Gorges National Park is roughly 300 times lower than our most conservative island-wide estimate. Shrestha *et al.* (2007) argued that public land managers could capitalize visitation rates by engaging more local outfitters and guides to help access natural areas and learn about the natural environment. Cho *et al.* (2014) pointed out that managers of national forests have the challenge of allocating already scarce resources towards policies and practices that can curb potential declines in visitation rates. Hein (2011) discussed how Hoge Veluwe Park in Netherlands built a successful business model that relies on recreation income from entry fees. They highlight that the park's high annual visit frequencies are directly related to the popularity of the park, its ease of access from urban areas and the variety of activities promoted by park managers e.g. photography workshops and provision of bicycles. All of these are

examples that state forest managers in Mauritius can adopt to increase the direct returns

on expenditure made for conservation management.

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4 USING SWOT ANALYTICAL HIERARCHY PROCESS TO ASSESS CONSERVATION PRIORITIES OF STAKEHOLDERS

4.1 Introduction

The willingness to gain a better understanding of complexities in social-ecological systems has led to identification of issues like inequalities in resource need versus resource ownership (Ostrom *et al.* 1999), power inequalities, unequal distribution of information and unequal management outcomes (Robards *et al.* 2011). Involving diverse stakeholders has been shown to result in improved management plans and in obtaining a wider range of information and perspectives needed for resource management (Colfer, 2005). Stakeholder participation is a mainstay of processes established by the Secretariat of the Convention for Biological Diversity (CBD) (2011) for signatory countries to prepare their National Biodiversity Strategy and Action Plans (NBSAP). Similarly, the United Nations Development Program (UNDP) has set up mandatory Social and Environmental Standards (SES), including as requirement that all of their projects and programs fully and effectively engage stakeholders and provide a means to address complaints from project-affected people (UNDP, 2014). Adopting these trends into national and international policy processes are often accomplished by making use of either a contracted consultant or project staff to structure the stakeholder engagement. However, constraints of time and project resources can limit the depth of understanding needed to capture how stakeholders interact and make decisions on natural resource management. Fritsch and Newig (2012) found that matching interests and goals of stakeholders was the single most determining factor in deciding the success of

environmental projects and policies. One of the most commonly used tools in stakeholder engagement processes is conducting an analysis of a project's or policy's internal strengths and weaknesses, and external opportunities and threats (SWOT). Our study provides an example of how SWOT analysis in conservation programs can be taken one step further towards actively recognizing priorities of stakeholders and customizing project outcomes to their needs where possible, or at the very least, minimizing perceived risks.

Small island developing states (SIDS) juggle heavily between conservation of their endemic biota and pressures on ecosystems from high population densities, small geographic size, economic development, limited local resources and limited local capacity (Teelucksingh *et al.,* 2013). Restricted land space on islands forces close proximity of resource users which in turn tends to magnify conflicts in natural resource management. Therefore, engaging stakeholders in policy formulation early in the process can bring greater flexibility in formulating strategies and greater acceptance of outcomes. Additionally, SIDS are amongst the most underfunded countries with regards to conservation (Waldron *et al.,* 2013; Miller *et al.,* 2013), such that finding innovative conservation strategies using limited resources requires input from a wide array of stakeholders.

The level of participation in policy formulation varies from a low level of public information to high level joint decision making processes (Arnstein, 1969). In the latter case, SWOT analysis is popular, but offers limited insight into individual stakeholder priorities and does not pinpoint the differential contribution of SWOT factors to

influencing decision-making. Hill and Westbrook (1997) also stated that the limits of

SWOT analyses are that the factors tend to be general in nature and will differ when a

single stakeholder is carrying it out as opposed to when the analysis is undertaken by an

external consultant, or by a group. Thus, generating prioritized factors, through SWOT

AHP, to guide conservation and exploring differences in those priorities between

stakeholders are key challenges facing conservation organizations in tropical island

communities (McLeod *et al.* 2016).

4.2 Methodology

4.2.1 Study Area

Mauritius is a small island developing state, part of the Mascarene Archipelago and

located in the Indian Ocean, 900km east of Madagascar. Along with Madagascar and the

Seychelles archipelago, Mauritius is recognized as a biodiversity hotspot (Myers *et al.*

2000), bearing 40 % of the region's single island floral endemics (Baider *et al.* 2010).

The biodiversity of the island, like many other oceanic islands, is heavily threatened.

Successive phases of colonization followed by rapid post-independence economic

development has reduced the extent of good quality native forests to less than 2% of the

land area (Page and d'Argent, 1997). Remaining natural habitats and terrestrial

ecosystems are heavily affected by plant and animal IAS and developmental pressures

(Mauremootoo, 2003). These same habitats and ecosystems are essential in the provision

of critical ecosystem services (freshwater, fertile soil, carbon storage, and weather

regulation), recreational benefits through outdoor sports, economic benefits through nature-based tourism as well as a range of other religious and aesthetic benefits.

The road to forest conservation on the island is paved with a number of successes, for example saving the *Falco punctatus* (Jones *et al.,* 1995), creating Conservation Management Areas (CMAs) (Baider and Florens, 2011), formal protection status for the Black River Gorges National Park, the Bras d'Eau National Park as well as seven nature reserves. Successful conservation strategies center on the eradication of IAS (Baider and Florens, 2011), creation of legal implements e.g. the Native Terrestrial Biodiversity and National Parks Act 2015, and captive breeding and release programs for native birds (Gardenne and Torto, 2017). Formulation and implementation of these strategies have to take into account a number of pressures. Firstly, forest remnants on the island span both state and privately owned lands where access for forest restoration can be restricted. Secondly, funding for conservation may not match restoration targets or be available to private landowners. Thirdly, loss of natural dispersers and pollinators as well as increased distance from source populations results in increased species loss (Gibson *et al.* 2013). This pressure on ecosystem health is increased when local government is lobbied to cull populations of important dispersers like the Mauritian fruit bat *Pteropus niger* (Florens, 2016). Other special interest groups that are affected by conservation strategies include deer ranchers and hunting associations, private land developers and nature-tourism operators.

Nonetheless, Mauritius has a good experience of engaging stakeholders for major national projects, typically through consultative workshops between private land owners,

state agency representatives (Forestry Service, and National Parks and Conservation Service) and non-governmental organizations (NGOs). The main biodiversity related projects and policies that we explored for this study are (i) National Biodiversity Strategy and Action Plan 2006-2015 (ii) Study on Environmentally Sensitive Areas (ESA) by the Ministry of Environment and National Development Unit (2008), (iii)"Expanding coverage and strengthening management effectiveness of the protected area network (PAN) on the island of Mauritius" project (UNDP and Global Environment Facility (GEF), 2009), (iv) the National Invasive Alien Species Strategy and Action Plan (NIASSAP) (2009), (v) the Maurice Ile Durable (MID) project (Mott McDonald, 2012) and (vi) the 2015 Native Terrestrial Biodiversity and National Parks Act. Each of these projects and policies incorporated consultative workshops with a wide range of local stakeholders, resulting in an exhaustive list of SWOT factors. The concerns and interests of stakeholders have been reported and listed at group level, but there is no documented evidence of priorities that drive the decision-making process of each stakeholder group when it comes to conservation. Our study uses the list of SWOT factors compiled through the above-named projects and policies and presents them to actors that use and are directly or indirectly affected by, or are benefitting from (Jolibert and Wesselink, 2012) native forest conservation on state and private lands in Mauritius.

4.2.2 Theoretical Specification

For our study, applying AHP to SWOT analysis was a three-step process. With SWOT factors pre-established, local priorities of factors are calculated using the eigenvalue method as the first step. For this, a reciprocal matrix is constructed by comparing one factor to another in a pairwise fashion, for each factor within the strengths, weaknesses, opportunities and threats categories in turn. Respondents are asked to rank the importance of one factor relative to another using a 9-point scale, as shown in the example below:

A 9 8 7 6 5 4 3 2 1 2 3 4 5 6 7 8 9 **B**

where 9 stands for "Extremely important", 5 for "strong importance", 3 for "moderate importance" and for "equal importance". Using this scale, if A is more important than B, a number is picked to the left side of "1". If B is more important than A, a number is picked to the right side of the scale from "1'. We also assume that comparing A to B is the reciprocal value of comparing B to A. A relative weight therefore is represented by a_{ij} and its reciprocal on the opposite side of the diagonal, as $1/a_{ij}$. Using the ranks as weights yields a square matrix of the form shown below, where n is the number of factors being compared:

$$A = \left[\frac{w_i}{w_j}\right] = \begin{pmatrix} w_1/w_1 & w_1/w_2 & \cdots & w_1/w_n \\ w_2/w_1 & w_2/w_2 & & \cdots \\ w_n/w_1 & w_n/w_2 & \cdots & w_n/w_n \end{pmatrix}$$

The comparison matrix A is then normalized by adding the values in each column and dividing each cell value by the column total. The normalized matrix is used to obtain local priorities of each factor by calculating the average of each row. Multiplying the transpose of the vector of weights w by matrix A we get a vector represented by λ_{max}w, where

$$Aw = \lambda_{max}w$$

and w = $(w_1, w_2, \ldots w_n)^T$, where λ_{max} is the largest eigenvalue of matrix A and w is the transpose of the vector of weights. In a consistent matrix, λ_{max} is equal to or greater then n (Saaty 1977). The consistency ratio (CR) of a matrix can be calculated using the formula:

$$CR = \frac{CI}{RI}$$

where $CI = \frac{(\lambda_{max}-1)}{n-1}$ and RI is the consistency index of a random matrix of order n. As a rule of thumb, Saaty (1977) recommends keeping the CR $\leq$ 10%. Alonso and Lamata (2006) argued that the consistency of a matrix depends on the scope and the decision maker's actual need, such that more flexibility may be required than a 10% cut-off. The second step of the methodology requires identifying those factors within each category with the highest local priority and using these as representative of its category. A second pairwise comparison is then carried out between the four SWOT categories. This calculation becomes a scaling factor used in the third step of the AHP method. This last step involves multiplying each local factor priority by the category scaling value to obtain a global priority for each factor. In simple terms, the local priorities allow for

ranking a factor within a category, whilst the global priority indicates a stakeholder's perception of the factor's relative contribution to its SWOT category (Ramirez *et al.* 2012).

4.2.3 Data collection

Following recommendations by the African Development Bank (2001), Jolibert and Wesselink (2012) as well as the Climate Investment Funds (2013), we broke down the list of stakeholders provided in the policy documents listed in Section 4.2.1 into two main categories. The first are key stakeholders that include scientists, policy-makers, forest land owners and local NGOs engaged in environmental initiatives. Secondary stakeholders include private companies with a corporate social responsibility (CSR) portfolio, hunting associations, tourism operators, outdoor sports professionals and facilitators like representatives and project leaders for the UNDP. A comprehensive contact list of stakeholders was built using (i) published contributors for the NBSAP (2006), ESA (2008), NIASSAP (2008), PAN (2009), MID (2012), and consultative workshops for the new native terrestrial biodiversity and national parks bill (Government Information Service (GIS), 2015) (ii) lists of CSR providers and non-profit environmental organizations eligible for CSR funding (National CSR Foundation, 2017). Stakeholders thus identified were invited to participate in a focus group, or participate in a one-to-one survey.

Saaty (1977) argued that cognitive limits in conducting pair-wise comparisons generally limit the number of factors in a SWOT category to ten. The focus group, held on 29th May 2015, was therefore tasked with firstly validating the list of factors to avoid

compiler bias, and secondly, streamlining the factors to a maximum of ten unambiguous factors per category, as shown in Table 13. In-person interviews with stakeholders who chose this method of participation in the study were conducted between 30th May 2015 and 20th August 2015.

Table 13: List of biodiversity conservation SWOT factors used to elicit preferences using AHP. Factors were validated through focus group discussions with Mauritian stakeholders.

Strengths		Weaknesses	
S1	Identification of IAS and good knowledge/research on management and control.	W1	Costs of setting up Conservation Management Areas (fencing + weeding) are very high, discouraging private landowners from investing in them.
S2	Known conservation status of native species and existing list of threatened and endangered species.	W2	Lack of public awareness of native species, ecosystem services and the need for their protection.
S3	River and mountain reserves already bear legal protection.	W3	Mountain reserves and forests on steep slopes are difficult to access or restoration and monitoring.
S4	Stakeholders actively engaged in national projects and policy	W4	Absence of consistent multiple land-use planning e.g. conservation

	processes on biodiversity conservation.		areas and buffer zones with deer pasture, nature-based tourism, plantation and infrastructure.
S5	Mauritius has made strong national and international commitments in terms of biodiversity targets.	W5	Deforestation due to lack of state monitoring and enforcement, or as a result of forest land leasing for deer ranching.
S6	Forests provide natural areas for recreation and leisure, favored by local population and tourists.	W6	Invasive Alien Species Strategy and Action Plan not disseminated to all stakeholders.
S7	New forest nurseries and expansion of existing ones can now support an annual re-afforestation program of 150 hectares.	W7	Absence of structured, time-bound and targeted management plans for all state, leased and private forestlands.
S8	Mauritius has already known a number of conservation success stories e.g. saving the Kestrel, creation of the Black River Gorges National Park, establishing the Vallee de Ferney public-private partnership.	W8	Absence of or limited habitat and species monitoring on leased and private forest lands.
		W9	Technical knowhow not exchange

		W10	Shortage of skilled local personnel for successful establishment and management of protected areas on state and private lands.

Plus above:

between state agencies and private land owners.

Opportunities		Threats	
O1	Public and private stakeholders have good awareness of IAS and associated problems.	T1	Absence of mitigation plans or short-term risks of large-scale IAS removal (erosion, soil compaction, non-aesthetic gaps, fire risk)
O2	A Protected Area Network funded by the UNDP-GEF is in discussion since 2009; PAN to include viable populations and representative habits, and cover 10% of land mass.	T2	Limited cooperative governance and partnership agreements to scale up forest restoration.
O3	Use of nature-based tourism and CSR to enhance conservation and sustainable use of biodiversity on state and private lands.	T3	Lack of control on where private nurseries source native plants for commercial sale, with risk of over-exploitation.
O4	Nurseries on private forest lands showing interest and capacity to	T4	Lack of incentives (e.g. tax rebates) to maintain native forests and

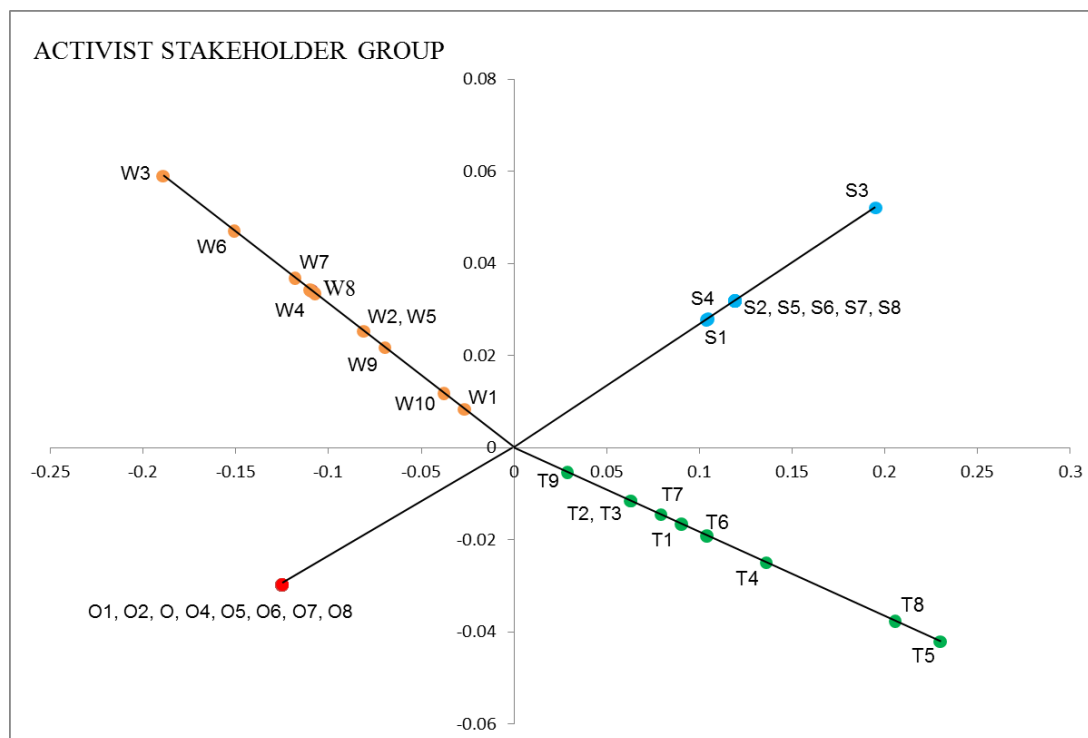|			
	grow native plant species.		sensitive habitats on private lands.
O5	Restoring native forests can take advantage of future economic tools in favor of ecosystem services.	T5	Limited restrictions on land-use and development in and near Environmentally Sensitive Areas.
O6	Forests can be actively restored through intensive eradication of IAS and reforestation.	T6	IAS control and management not undertaken on a large scale.
O7	Communities and users show increasing appreciation of restored forests – media coverage, nature-based recreation, green jobs and other volunteer-based capacity building.	T7	Deer ranching is difficult to regulate. Even if deer is a listed IAS, it is a significant source of income.
O8	Cost effective IAS control methods known and are available (e.g. drill and herbicide; cut and herbicide; ring barking).	T8	Staffing levels and budget allocation within state agencies (FS and NPCS) are low.
		T9	Binding agreements are formulated on the basis of lack of trust and lack of transparency from parties involved.

4.2.4 Survey Design

The survey for eliciting factor preferences was structured into three parts with the first

providing an introductory script explaining the purpose of the study, the second part

provided a grid system for the pairwise comparisons of SWOT factors and the third part

provided another grid system for the pairwise comparison of SWOT groups. The survey

was accompanied by a Powerpoint^{TM} presentation with a worded pairwise comparison on

each slide to help respondents, an example of which is "S1 – Identification of IAS and

good knowledge/research on management and control vs. S6 – Forests provide natural

areas for recreation and leisure, favored by local population and tourists". Because of the

one-on-one nature of the interview, respondents had ample opportunity to clarify the

SWOT factors and understand the methodology, such that their final responses could be

taken at face value. Surveys and the focus group agenda received institutional review

board approval prior to deployment in Mauritius.

Once all preference weights were input, respondents were asked to state the stakeholder

category they best saw themselves in, or best identified as. For groups with more than

one respondent we used the geometric mean (Saaty, 2001) to obtain the local and global

priorities, whilst other individuals were assumed to be representative of their stakeholder

group. We used the local and global priorities of factors to create perception maps for

each stakeholder group in an XY space, similar to Ramirez *et al.* (2012). We also

assessed those factors that held the highest and lowest global priority rankings across all

stakeholders in the study.

4.3 Results & Discussion

One of the main advantages of SWOT-AHP is that it does not necessitate a large response sample, but can target people knowledgeable of the issue at hand (Shrestha *et al.,* 2004). We had 22 respondents in total, classified into 11 stakeholder types namely 'activist group', 'agriculture group', 'environmental consultant group ', 'large corporation group', 'non-profit organization group', 'outdoor sports group', 'scientist/ecologist group', 'sugar estate group', 'state agencies group', 'hunting association group' and 'facilitators' group'. A scatterplot of prioritized SWOT factors for each of these stakeholder groups is shown in Figures 7a to 7k.

For the "activist" stakeholder group, existing legal protections for river and mountain reserves (S3) are the strongest perceived strengths, difficulty in accessing forests on mountains and steep slopes for effective restoration (W3) is the strongest perceived weakness, and absence of adequate restrictions on land-uses and development near ESAs (T5) is perceived as the strongest threat. The "activist group" also perceived all opportunities to bear equal importance. Our findings for this stakeholder group are in line with Wapner (1995) who suggested that activists typically see their role as being political influencers, acting as pressure groups on state policy makers.
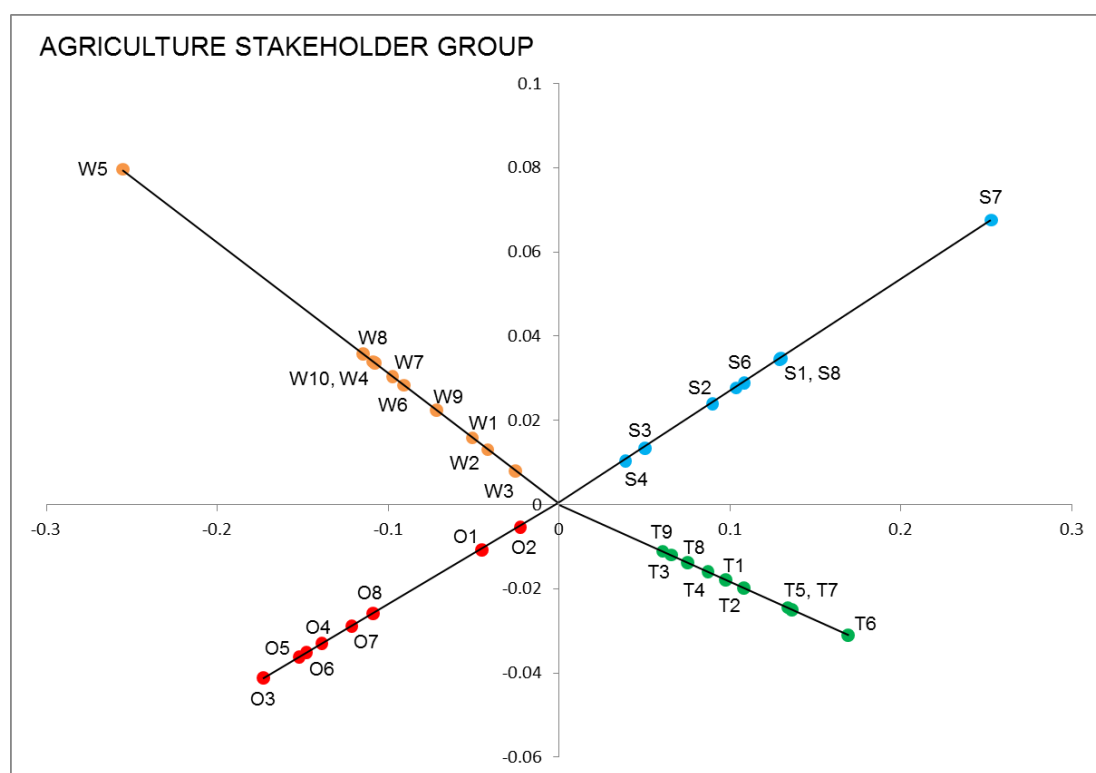
Figure 7a: Preference map of SWOT factors for "Activist" stakeholder group.

For the "agriculture" stakeholder group, the ability of plant nurseries to expand operations and propagation of native plants for afforestation (S7) is perceived as the most important strength, whilst absence of adequate enforcement and monitoring on state forest lands to avoid deforestation (W5) is seen as the most important weakness. The opportunities presented by CSR funding and nature-based tourism (O3) have the highest importance and not eradicating IAS on a large scale (T6) is perceived to be the most important threat. The agricultural community on the island is affected by loss of soil fertility from legacy deforestation (Norder *et al.* 2017) and land abandonment as small land owners shift occupation choices based on social–economic factors (Lalljee and

Facknath, 2008). Even if Mauritius relies heavily on food imports, local agriculture

remains threatened by soil loss, increased water runoff, lower infiltration rates, and lower

water-holding capacity (Pimentel *et al.* 1995). The set of SWOT factors favored by this

stakeholder group suggests that the ecosystem service links between agriculture and

forests are well understood and there is a willingness to contribute to enhancing those

links. Additionally, propagating native species and replanting these on marginal and

abandoned lands is part of the PAN project and can arguably bring future economic

benefits to private land owners and nursery managers.

Figure 7b: Preference map of SWOT factors for "Agriculture" stakeholders.

The "environmental consultant" stakeholder group perceived the participation of

stakeholders (S4) as the most important strength, absence of a land-use master plan (W4)

as the most important weakness, and absence of trust and transparency (T9) as the most

significant threat. Three opportunities dominate this stakeholder group's ranking; they

are the creation of the protected area network for the island (O2), capacities for native

plant propagation by private nurseries (04) and development of economic tools for

ecosystem services (05). These trends are in line with Sardo and Weitkamp (2017) who,

using Portugal as a case study, found that environmental consultants see themselves as

knowledge brokers, bringing and encouraging the use of scientific, technical and socio-

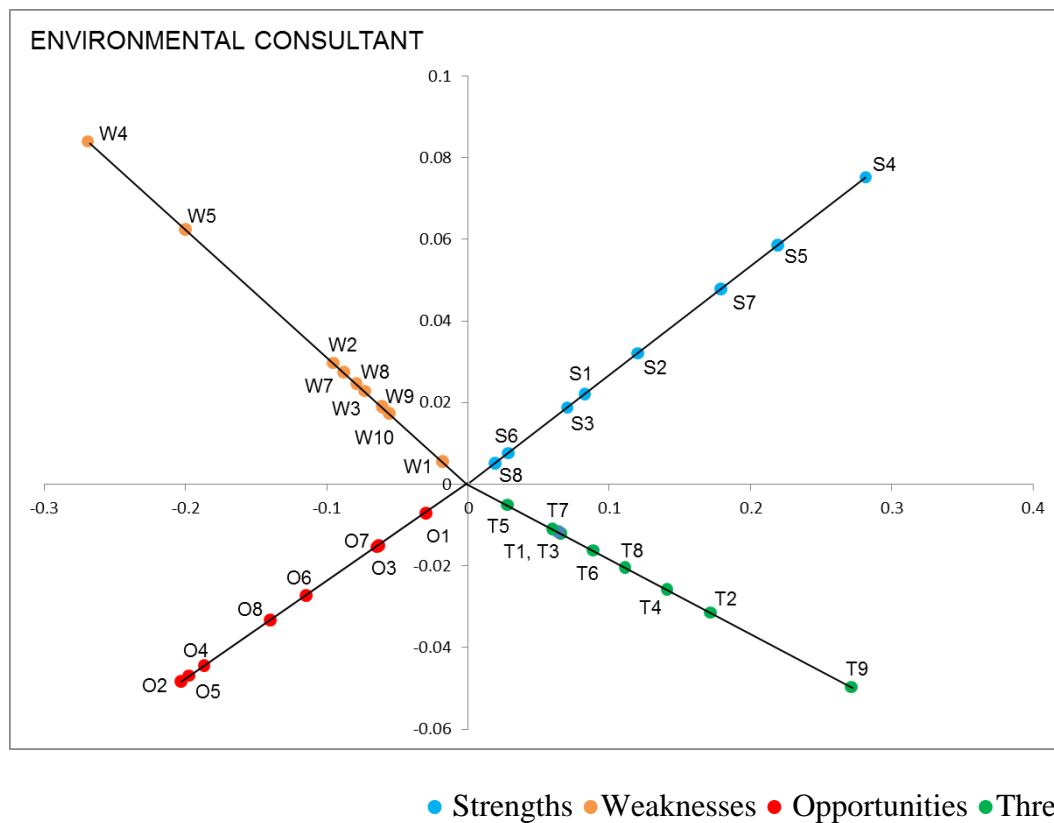economic information to policy makers.

Figure 7c: Preference map of SWOT factors for "Environmental Consultant" stakeholder group.

The "large corporation" stakeholder group perceived the conservation successes (S8) as the most important strength. Similar to the "agriculture" stakeholder, the "large corporation" viewed absence of state monitoring and enforcement (W5) as the most important weakness. It however aligned with the "environmental consultant" in viewing capacities for native plant propagation by private nurseries (04) as an important opportunity.
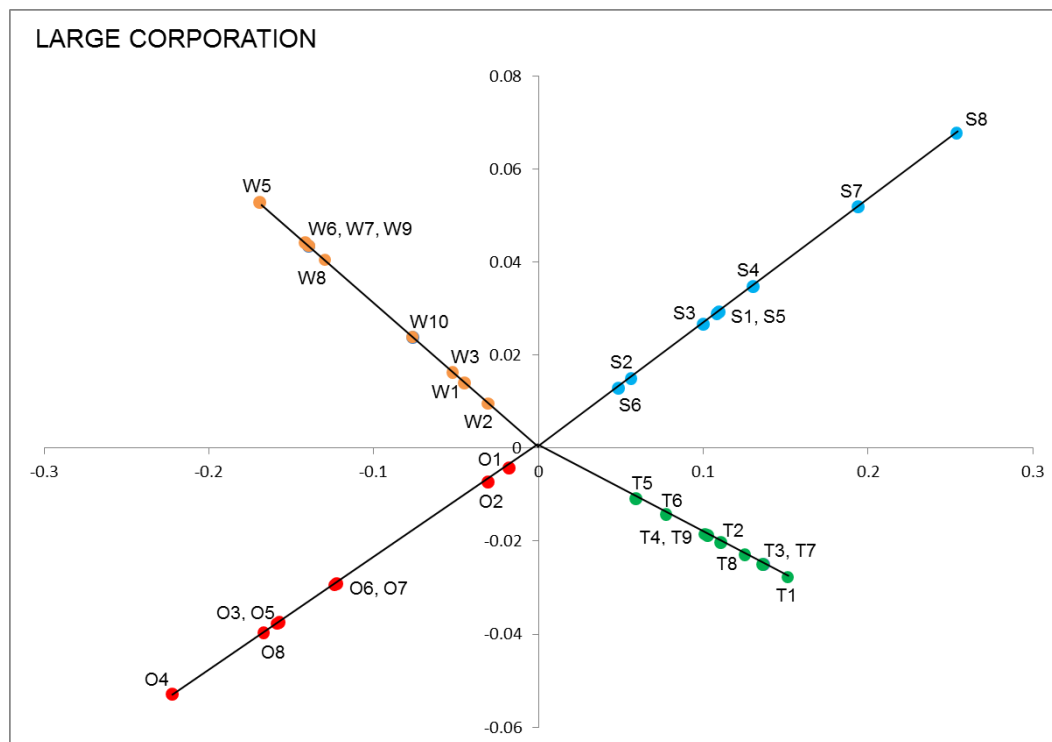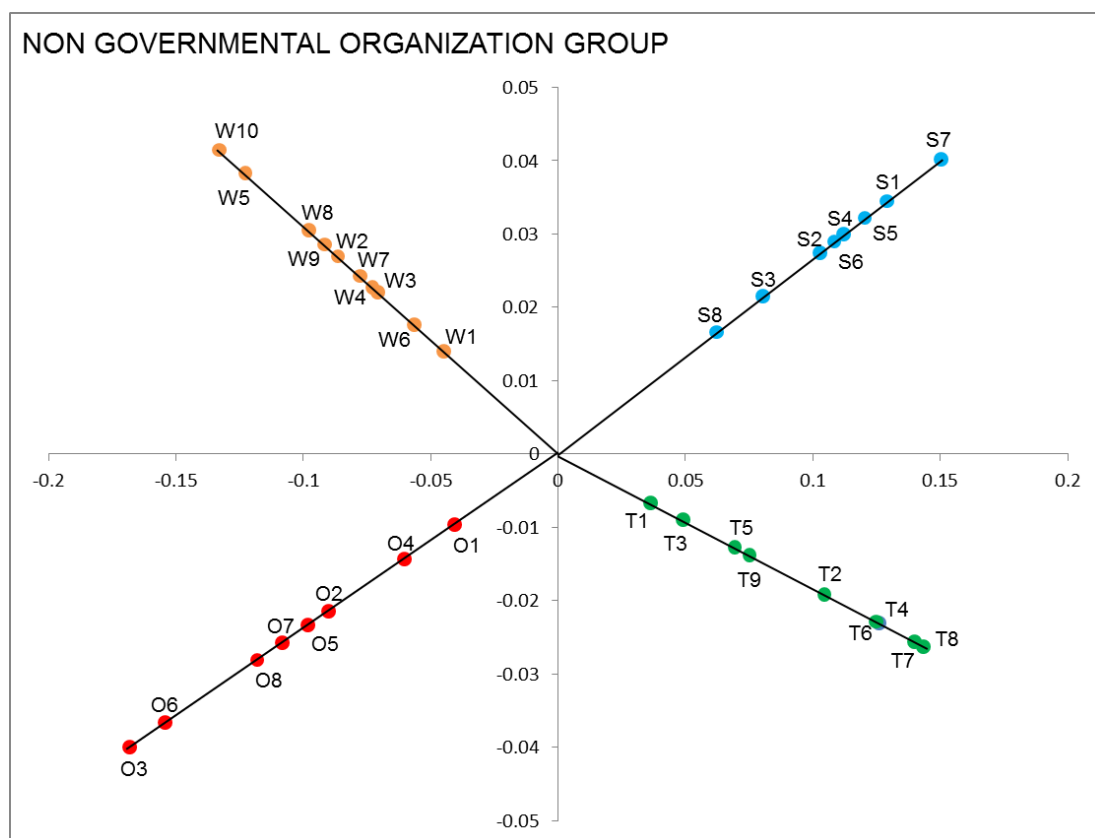
Figure 7d: Preference map of SWOT factors for "large corporation" stakeholder group.

Similar to the "agriculture" stakeholder, the "non-governmental organization" stakeholder group perceived the expansion of existing nurseries and the setting up of new ones to increase re-afforestation programs (S7), as the most important strength. They also equally perceived opportunities presented by CSR funding and nature-based tourism (O3) as having the highest importance. They perceived the shortage of skilled local personnel for successful establishment and management of protected areas on state and private lands (W10) as the most important weakness. Lastly, they perceived deer ranching (T7) and low staffing levels and low budget allocation within state agencies (T8) as highly important threats. Under the S50L of the Income Tax Act of Mauritius

(Act 16 of 1995), all but specially-exempt companies registered with the Registrar of Companies of Mauritius have to put two percent of their book profits into a CSR fund to be used by approved non-governmental organizations for projects with social and environmental benefits (National CSR Foundation, 2017). Many non-governmental organizations on the island have been able to tap into CSR funds to hire more volunteers, employ more staff and diversify their operations (for example by setting up their own plant nurseries), allowing them to maximize S7, make up for W10 and mitigate T8.

Figure 7e: Preference map of SWOT factors for "non-governmental organization" stakeholder groups.

The "outdoor sports" stakeholder group comprises of people who use outdoor sports as their source of income by providing guided bike tours or mountaineering trips. They perceived the national and international commitments made with regards to environmental protection (S5) as the most important strength, a preference which we can attribute to their reliance on well-preserved natural environments. Similar to the "agriculture" and "large corporation" stakeholders, the "outdoor sports" stakeholder perceived absence of state monitoring and enforcement on forestlands (W5) as the most important weakness, and low staffing levels and low budget allocation within state agencies (T8) as a highly important threat. They related W5 and T8 to the unregulated field of outdoor nature sports where large groups have been known to go on difficult terrain with poor safety equipment and inadequate training. Limiting the risk of harm to users and risk of damage to critical habitats and species is made difficult by the unsupervised, open and free access to the national parks and nature reserves. Lastly, they view the appreciation of communities and users for restored forests (O7) has the most important opportunity which can be associated to the variety of nature-tourism and adventure sports operators on the island, as well as the popularity of trail running, with events like the Rando Raid, Ferney Trail, Parakeet Challenge and 15 other trail races held annually, across the island (http://www.randotrail.mu) and which attract thousands of domestic and international participants.
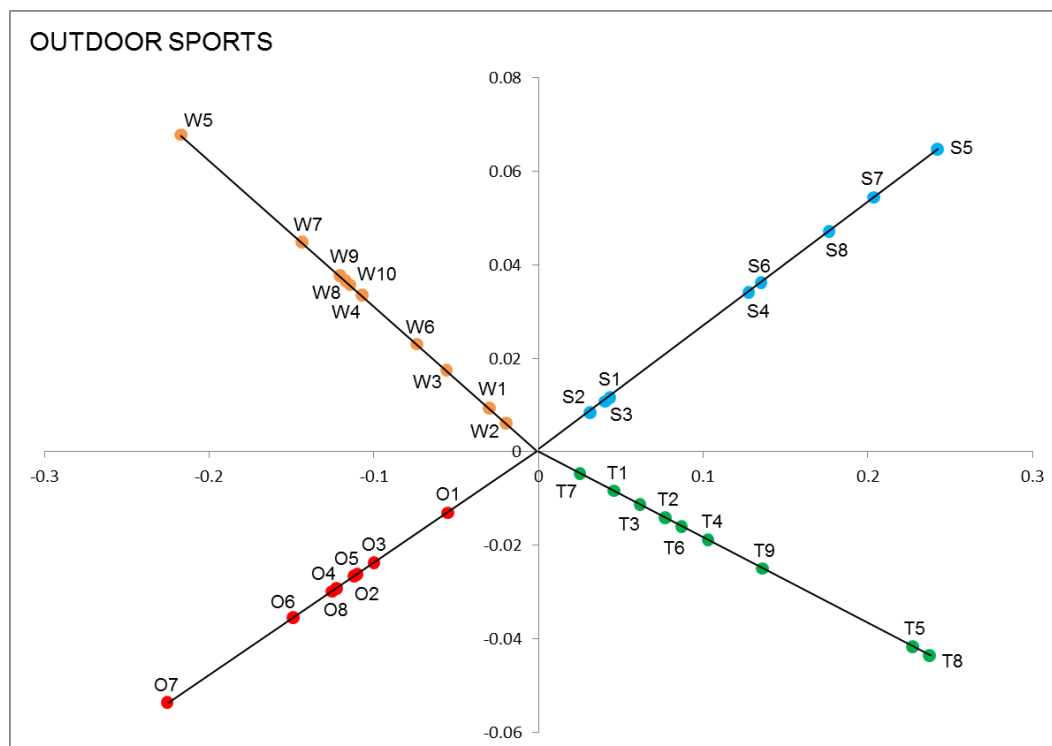
Figure 7f: Preference map of SWOT factors for "outdoor sports" stakeholder.

The "scientist/ecologist" stakeholder group perceived the identification, management and control of IAS (S1) as the most important strength. Moon, Blackman and Brewer (2015) highlight that eradicating invasive species from inhabited areas is a much more considerable challenge for scientists and decision-makers because of differing stakeholder perceptions, in addition to source areas of IAS, for example on private forest lands. This explains the higher perceived threat importance given to the absence of large scale IAS control and management (T6). However, research into their control and management has yielded cost-effective forest restoration methods (Dulloo *et al.,* 2002;

Gopal, 2003; NIASSAP, 2009; Florens *et al.* 2010; Florens and Baider, 2013) that can easily be applied to both state and private forestlands and can be funded more easily. Similar to the "environmental consultant" stakeholder, scientists perceived absence of a land-use master plan (W4) as the most important weakness and ranked top-most the opportunities that can be offered through nature-based tourism and CSR (O3).
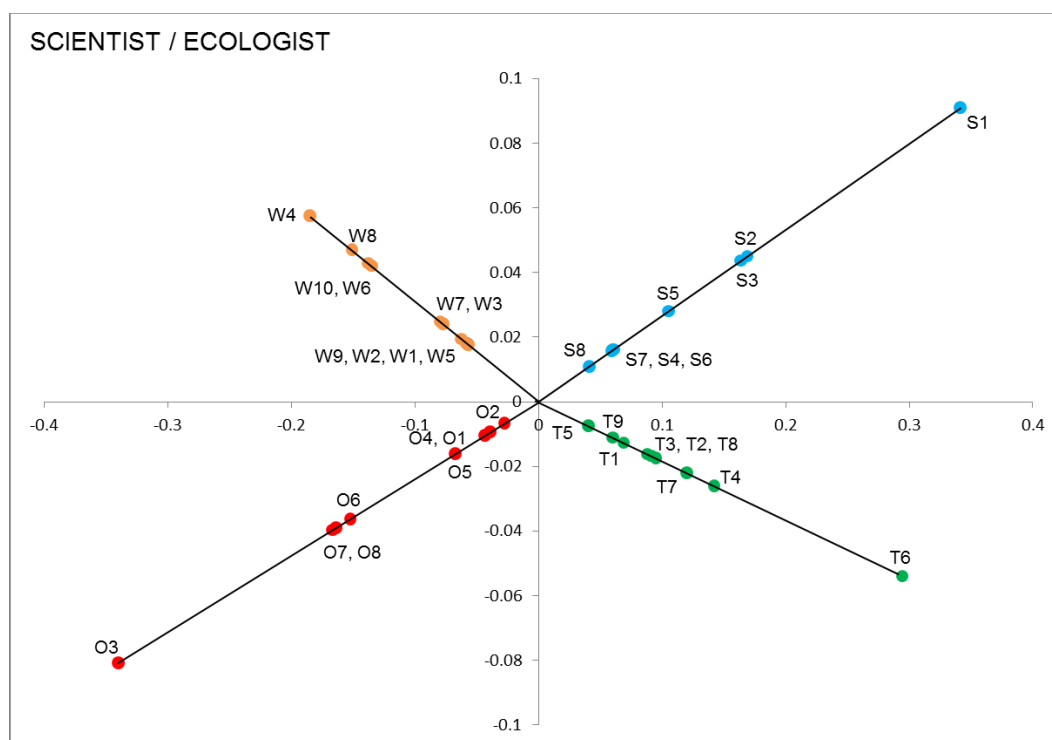
Figure 7g: Preference map of SWOT factors for "scientist" stakeholder.

The "sugar estate" stakeholder group perceived the history of conservation successes (S8) as the most important strength. The economic tools that can be used in favor of ecosystem services (O5) and rapid restoration that can be achieved through intensive eradication of IAS and reforestation (O6) are perceived as high priority opportunities.

Sugar estates on the island date back to colonial times and are for the most part privately owned. These estates also include significant tracts of remnant native lowland forests as well as land reserved for deer ranching and hunting. These forests, especially those not included in mountain reserves, would almost certainly have been cleared if not for hunting (Mauremootoo *et al.*, 2003). Though many privately owned forests are heavily degraded state, they represent the most extensive and best-conserved lowland forest in the Mascarenes (Mauremootoo *et al.*, 2003). Some land owners have invested in maximizing use of these forests through nature-based tourism (for example La Vallee de Ferney Forest and Wildlife Reserve, Le Domaine de L'Etoile, Ebony Forest), whilst in other areas, large owners turned the landscape into an asset for integrated resort schemes. As a key stakeholder, these large land owners recognize the economic benefits to be gained from conservation but will favor public-private partnerships with the state (for example La Vallee de Ferney Conservation Trust) and access to green grants. "Sugar estate" stakeholders view the lack of habitat and species monitoring on their lands (W8) as the top-most weakness, and perceive the low staffing and budget levels of state agencies (T8) as the most important threat. This suggests that as large forestland owners, they need better support to gauge the ecological value of their properties but fail to see state agencies as being able to provide that support.
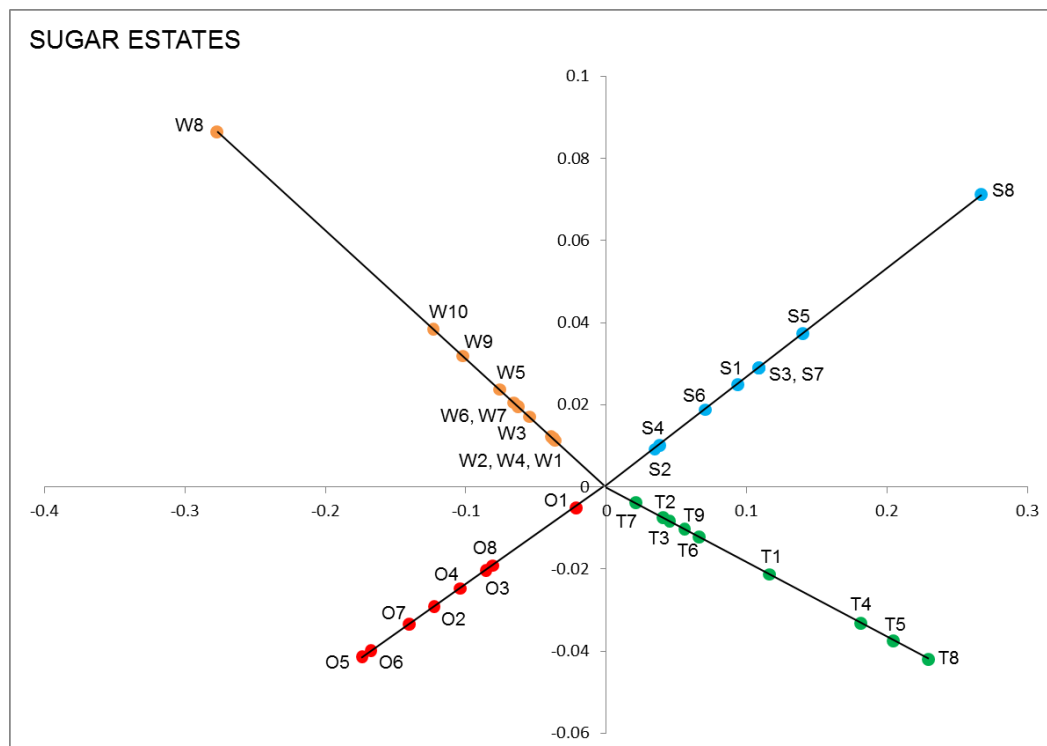
Figure 7h: Preference map of SWOT factors for "sugar estate" stakeholder.

"State agencies" stakeholders give a high degree of importance to conservation successes already achieved locally (S8) and view the cost effective IAS control methods available (O8) as the most important opportunity for conservation programs. They however view the lack of public awareness of native species, ecosystem services and the need for their protection (W2) as the most important weakness and the lack of incentives (e.g. tax rebates) to maintain native forests and sensitive habitats on private lands (T4) as the most important threat. The state agencies on the island comprise of the Forestry Services which manage the Nature Reserves and Forest Reserves, and the National Parks and Conservation Service which oversees the management of the National Parks, most

offshore islet Nature Reserves, the Bird Sanctuaries and Ancient Monuments. Low staffing and budget levels limit the available human resources to invest in consistent public education programs on conservation and forests. Steinberg (2005) argued that policy decisions regarding biodiversity conservation require information input from a range of sources, as opposed to relying on central planners only. They suggested that in addition to the regular stream of information from scientists, environmental non-profits and other typical stakeholders, citizens can provide useful ecological information. Thus for Mauritius, we suggest that using more modern means of engaging the public (for example social media or smartphone applications) can reduce W2 and leverage public support. With regards to mitigating or eliminating T4, the PAN project (2009) offers opportunities to develop bilateral and multi-lateral partnerships with private land owners and the creation of a future land stewardship council to protect ESAs. These conditions of the PAN project are still in the works.
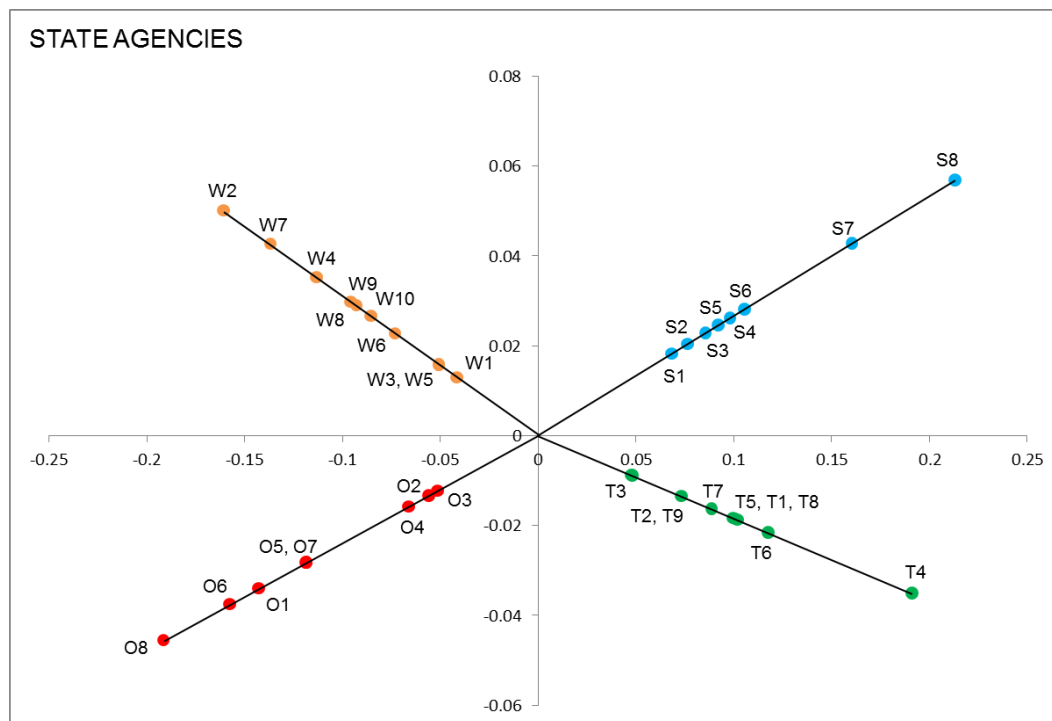
Figure 7i: Preference map of SWOT factors for "state agencies" stakeholder.

The "hunting association" stakeholder group perceived the history of conservation successes (S8) as the most important strength, similar to the "sugar estate" and "large corporation" stakeholders. They perceived shortage of skilled local personnel for successful establishment and management of protected areas on state and private lands (W10) as the most important weakness, similar to the "non-governmental organization" stakeholder group, but perceived lack of incentives for conservation on private lands (T4) and the lack of trust and transparency in multi-partite agreements (T9) as the most important threats. From Table 1, an estimated 250 km^2 of land in Mauritius is used for deer ranching and deer hunting purposes. Mauremootoo *et al.* (2003) provide a

discussion of the repercussions of deer ranching on native forests, highlighting that

ranchers have cleared tracts of native forests to provide hunters with a clear line of sight,

as well as to create grass pastures. Deer ranching operations stock deer in densities of 70

to 600 heads per km^2 and this creates repetitive, destructive and indiscriminate herbivory

pressures on the native vegetation, which has not evolved in the presence of these

animals (Mauremootoo *et al.*, 2003). Our discussion in Chapter 2 recognized that

restoration efforts for forests that are on or near hunting grounds may well require

investment into the setting up of fenced CMAs. The higher costs associated to this form

of conservation project likely influence this stakeholder group's priority for incentive
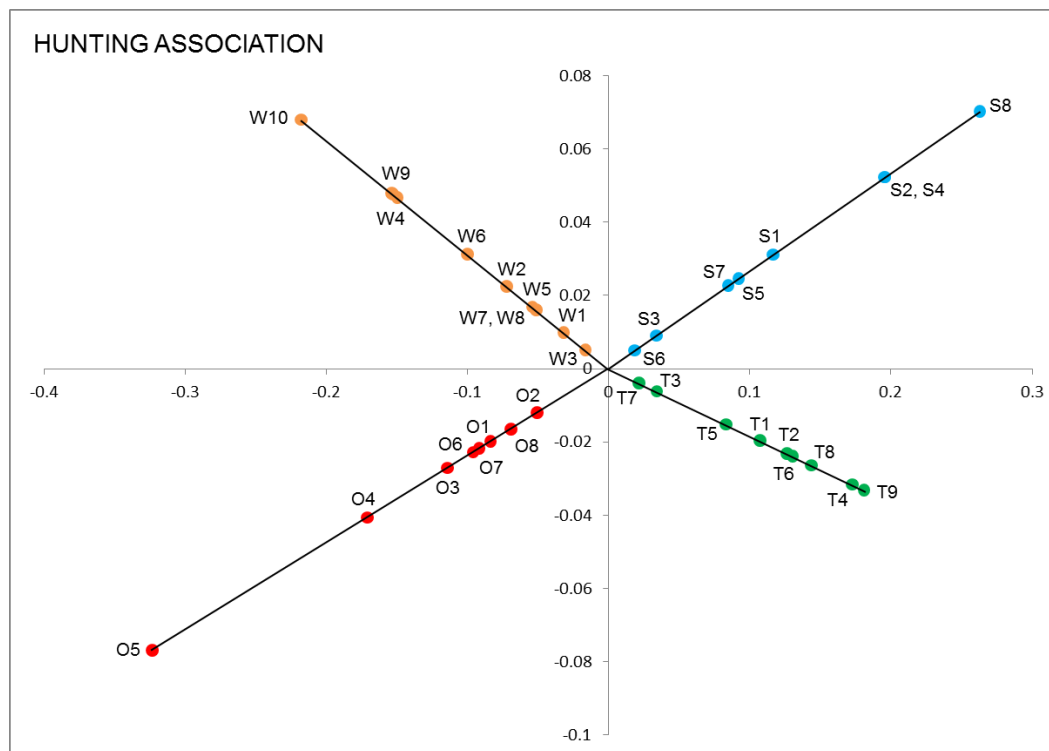
packages.

Figure 7j: Preference map of SWOT factors for "hunting association" stakeholder.

Similar to the "outdoor sports" stakeholder group, the "facilitator" stakeholder group perceived the national and international commitments made in terms of conservation targets (S5) as the most important strength. Like the "sugar estate" stakeholder group, they see the development of economic tools in favor of ecosystem services (O5) as the most important opportunity. Along with the "environmental consultant" and "scientist/ecologist" stakeholder groups, they perceive the absence of a land-use master plan (W4) as the highest priority weakness. Lastly, low staffing and budget levels of state agencies (T8) were perceived as the most important threat to conservation programs,

a priority threat shared by the "non-governmental organization" stakeholder group, the "outdoor sports" stakeholder group and the "sugar estate" stakeholder group.
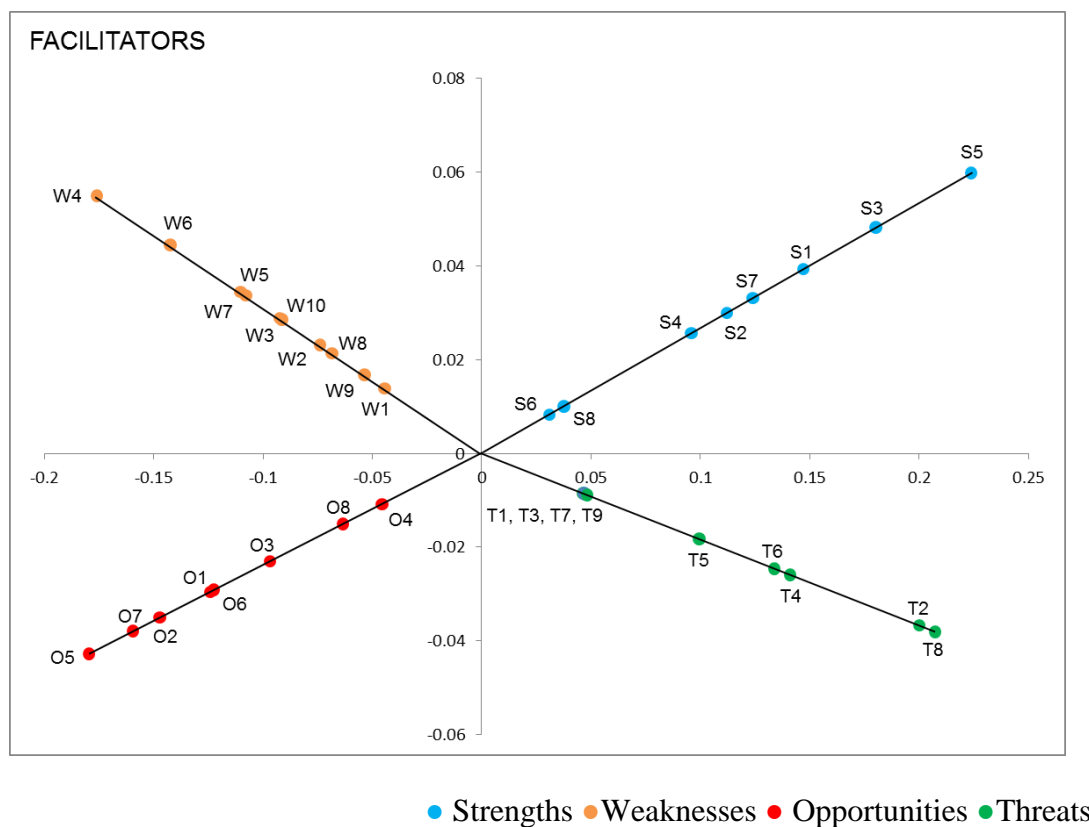

Figure 7k: Preference map of SWOT factors for "facilitators" stakeholder.

From Table 14a, the low staffing and low budget levels of state agencies (T8) is given high priority four times, whilst absence of consistent land-use planning (W4) and absence of state monitoring and enforcement on forestlands (W5) are each given high priority three times. It is very possible that state agencies in Mauritius will never have enough manpower and financial resources for a fully effective, long-term enforcement of all protection laws for all forestlands under their jurisdiction. But since those threats and weaknesses are ranked highly by agriculturalists, outdoor sportspeople, corporations, sugar estates (private forestland owners), and hunting associations, resolving this conflict is a key determinant for conservation strategies on the island. Brechin *et al.* (2002) argued that it is more practical to negotiate agreements with stakeholders in a way that all participants view their roles and expectations as legitimate and feasible. They also suggest that the organizational challenges of biodiversity conservation can be mitigated with self-enforcement from the part of all stakeholders, as opposed to relying on forced compliance by the state. In the case of Mauritius building on existing conservation successes which include the only conservation-oriented public-private partnership (S8) offers the opportunity for applying the suggestions of Brechin *et al.* (2002).

Woodford *et al.* (2016) recognized that a myriad of contrasting perspectives, multiple objectives, and targeting too many management goals can make resolving issues in policy and project implementation, difficult. It can be all the more difficult to satisfy every stakeholder. However, conservation programs can be rendered more efficient when systems and institutions can mitigate threats and take advantage of opportunities. Margles *et al.* (2010) used SWOT AHP to show that it can be a powerful method to

engage different stakeholders in an open and transparent process, encouraging

communication of preferences and allowing for both conflict resolution and compromises

in strategies.

Table 14a: Number of times a factor had highest global priority across all groups. Only

factors appearing more than once are given.

Strengths	Freq.	Weaknesses	Freq.	Opportunities	Freq.	Threats	Freq.
S8	4	W4	3	O3	3	T8	4
S5	2	W5	3	O5	3	T6	2
S7	2	W10	2			T9	2

Table 14b: Number of times a factor had lowest global priority across all groups. Only

factors appearing more than once are given.

Strengths	Freq.	Weaknesses	Freq.	Opportunities	Freq.	Threats	Freq.
S8	3	W1	5	O1	5	T5	3
S6	3	W3	3	O2	3	T7	3
S1	2	W2	2			T9	2
S2	2					T1	2

Tables 14a and 14b show that no single factor dominated the stakeholder collective in

terms of highest or lowest priorities. This suggests that SWOT AHP can be a valid

complementary method to policy formulation and planning purposes. Even if policies are

typically formulated and implemented within short decision time frames, and are subject

to political pressures as well as legal and bureaucratic barriers (Lach *et al.* 2003),

adaptive management strategies can still be put in place to cater for shifts in

demographics and economics. Changing environmental, social and economic conditions

can alter stakeholders' preferences, such that the elicitation of these preferences should

occur at a acceptable frequency. It can be especially beneficial as a means of evaluating

project and policy impacts.

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5 CONCLUSION, POLICY IMPLICATIONS & FUTURE WORK

5.1 Environmental Policy Implications

Local experts and agency representatives consulted during the focus group meetings suggested that various state-owned and state-managed sites on the island may be subject to entry fees in the near future. Buckley (2003) provided a thorough discussion of entry fee systems for parks. He recognized that land managers may charge visitors for general admission into the park, access to specific areas or fees for specific activities such as climbing. State agencies in Mauritius do not allow camping or overnight stays on public forest lands but private landowners can provide facilities for lodging, camping, mountaineering, rafting, diving, in addition to existing facilities for quad biking or horseback riding. Buckley (2003) also pointed out that managers can issue permits for commercial tour operators and charge at the application, licensing and renewal processes. Private nature-tourism operators on the island charge fees from visitors for guided and non-guided hikes, whilst visitors to public lands can hire a freelance guide for their trips and pay the guide directly. If state agencies wish to capitalize on guided tours, they can hire their own guides or train rangers to provide this service, against a fee. Commonly, however, visitor fees are understood to refer to charges imposed by landowners and land management agencies on either independent visitors or commercial tour operators and their clients, for entry, admission, overnight stays, recreational activities and tours, educational walks and talks or use of recreational and/or educational facilities.

Competitiveness of state-managed sites can be increased by investing in visitor-friendly amenities at points of entry, e.g. security personnel or cameras for parking lots, guides and customer service representatives, regular garbage collection and modern restrooms. Designing packages for repeat visitation could be beneficial in encouraging paid-visits. In Section 5.2 we highlight that different sites have different appeal to domestic and international visitors, with some sites being more popular than others. In Section 1.6.5 we also point out that some forest areas are not easily accessible to visitors, either because the access track is small and unmarked, or the area is specifically restricted. With regards to funds raised through entry fees, there are two possible policy alternatives. Firstly, state-managed and privately-managed sites collect funds for direct use at the site of interest. Secondly, an approach similar to that used by the United States National Parks Service (USNPS) can be employed, where sites retain 80% of visitor-generated revenues, and divert remaining 20% to a centralized pot of money for disbursement to other national parks' projects (Calfas, 2017). Ensuring that a portion of funds goes to a centralized system may allow forest areas that do not or cannot get regular visitors, still benefit from a cash influx.

With regards to the use of funds generated from entry fees, our premise is for funds to be directed towards forest restoration efforts. Even if favoring active invasive plant species weeding has proven to be effective, there are scenarios that may call for more material and labor intensive protection in the form of fenced CMAs. Mauremootoo (2017) reports that total fencing cost were at USD 70 per running meter in 2003 (USD 110 when adjusted to 2017 prices; and using an exchange rate of USD 1 = MUR 36). He also

recognizes that fencing would be appropriate in areas with high deer and pig densities – e.g. in or near deer ranching lands, and in areas where land managers seek to control public access.

With regards to sources of funds for restoration, we used the study to advocate for entry fees as a sustainable way to raise money, but this should not come at the expense of efforts to secure research grants, international aid, corporate social responsibility funding or encouraging more effective, efficient and equitable allocation of Government funds. The roles and functioning of the FS and NPCS were not discussed in detail in this thesis, but suffice to say both agencies have a significant amount of overlap in their duties and jurisdictional range but differing budget allocations and staff levels, to the point that one way to consolidate use of scarce funds may well be merging these two similar state agencies.

The International Union for the Conservation of Nature (IUCN) has established categories for protected areas with a breakdown of permissible activities ranging from strict protection to sustainable uses (Dudley, 2008). Currently the national parks and nature reserves of the island are not integrated within an IUCN-style classification. Given the small size of the island, land use classifications around protected areas will have to accommodate the relative closeness of a range of operations to public forest lands. A properly defined sustainable land use classification can allow state agencies or private contractors to rent out equipment, operate transport and accommodation facilities, as well as retail shops, within the parks or near nature reserves. Other sources of income

can come from licensing for commercial activities such as filming, bee-keeping and sports competitions.

Our findings in Chapter 3 show that even conservative estimates of travel cost and total visitor count yield a high recreation value for Mauritian forests. Whether the user demand wanes between simple daily recreation, to infrequent sophisticated forms of recreation, there are clear benefits to be gained by protecting forested areas and investing in sustainable nature-tourism practices. State managers can tap into the demand for outdoor recreation through entry fees and any of a number of possible activities, generating jobs in the process and offsetting, at least in part, conservation costs. Private forestland owners are already investing in a growing outdoor recreation culture and coupling these to local food, crafts and outdoor gear businesses. It is important for private land owners to also invest the returns in conserving the main raw material of their industry through conservation management of their forests. Maintaining demand for forest recreation and discovery is centered on improving annual visit rates. Our results suggest that this can be achieved with investments in public education and awareness campaigns on the value of forests to Mauritian society, as well as promoting public identification and appreciation of native species. Visit rates can also be improved by promoting greater understanding of the participatory role of residents in conservation and improving communication from forest managers on their work and challenges. From education, sensitization and communication standpoints, the use of smartphone applications and social media are severely limited or non-existent, especially from state agencies. Minin *et al.* (2015) argued for using social media to gather visitor-supplied

data on spatio-temporal changes in ecosystems, values attached to a site, and activities carried out by different groups of people in a natural area, to inform conservation science. They suggest that engaging social media users can create more awareness and become a campaigning platform for biodiversity-related issues. They also recognized that social media data comes with posters' biases and knowledge limitations, but can act as a viable complement to existing research and nature communication programs.

The 2017-2020 Black River Gorges Management Plan is a key policy instrument, but provides no information on the methodology and validity of the studies used for their reported willingness to pay values. Chapter 2 and 3 of this thesis on the other hand provide a means to replicate our studies, and improve the findings by collecting a larger data sample and from a wider array of forested areas. Our findings and methodologies are a much better fit for forest management plans, both for public and private forestlands. In Chapter 4, we show that SWOT AHP presents a much more robust analysis of stakeholder preferences with the potential of adjusting project or policy deliverables accordingly. Our findings show that state and private landowners favor expansion of existing nurseries and the setting up of new ones to increase re-afforestation programs. They also see corporate social responsibility and nature-based tourism as viable strategies to tap into. For scientists, conservation policy should be driven by management of invasive alien species. Other stakeholders view their continued participation in conservation policy formulation as a strong factor to keep building upon, but seek to address the lack of legal enforcement in forestlands as well as development threats to environmentally sensitive areas. Overall, stakeholder needs and priorities can conflict

one another, or matching one set of preferences can have unforeseen consequences on project or policy outcomes. Nonetheless the merits of gaining deeper, more detailed insights out of stakeholder engagement cannot be understated. We argue that conservation strategies can integrate multiple management versions based on SWOT AHP outcomes and obtain better stakeholder buy-in than a one-size-fits-all solution. For example, given the priority given to expansion of native plant nurseries, nature-based tourism and dealing with the lack of skilled personnel for protected area management, this suggests that significant support can be generated for the creation of green jobs as horticulture specialists, nature-tourism guides and forest managers. The high priority given to corporate social responsibility as a source of funds suggests that corporations may be open to increasing their legally-defined contribution. The limitations of the current formulation of the CSR program are discussed in Section 5.2. With regards to establishing partnerships, stakeholders have shown a bias towards relying on the involvement of state agencies and large forest land owners. We suggest that community organizations living near forestlands of interest can and should be encouraged to act as a stakeholder group. Opportunities exist for villages and townships to partner with the FS, NPCS and private forestland owners to develop green businesses, green jobs and promote environmental stewardship and education.

5.2 Study Limitations & Future work

Chapter 2 focused on the use of contingent valuation. Arrow *et al.* (1993) provide a thorough discussion of the CV methodology and its limitations. Our formulation of the contingent valuation hypothetical market focused on the direct use of the forest areas for recreation. This iteration of the study did not address the recreation value attached to forest areas by people who were not at the site on survey days. The analysis can benefit from more data collection streams that extend findings to domestic and international visitors at non-forested areas (food courts, supermarkets, shopping centers, beaches, hotels, city and town centers, museums). Any additional surveys should also attempt to collect data during peak visitor season, between September and January and assess if WTP values differ from those expressed by off-peak visitors. Our findings are also in response to the model chosen in this study such that using other regression forms or factorial analysis will yield different explanatory relationships.

With financing conservation, the transparency of allocating funds relies for the most part on self-monitoring, be it for private or public land owners/managers. It is also likely that more popular sites may raise more income during the year, than less popular or less accessible sites. A week's worth of survey days at Vallee d'Osterlog forest area (Site 8 in Figure 4) yielded only two responses. The site's staff reported not seeing as many visitors as the more popular National Parks, even during peak visitor season. Even if the site is stated owned, and has high ecological value, access to the site is limited by an unsurfaced and unmarked private road. Relying on entry fees here as a source of funding for conservation may not be a viable option, until the site is more popularized and access

is facilitated. Having entry fees at sites that are currently free does pose problems of discrimination against low income people. Managing the money flow entails administrative work, but also poses the risk that prioritizing revenue can come at the expense of resource protection. Setting up an entry fee system, or increasing existing fees can also be a hassle and an inconvenience to visitors.

The travel cost study presented in Chapter 3 targeted only domestic visitors at the sites elucidated in Figure 5. Future travel cost surveys should target a wider range of residents at off-site locations to get a closer-to-reality reflection of people's forest-visiting habits. Future surveys should also be carried out during peak visitor seasons between September and January to cover year-long trends. A more important future extension of this work is to create and administer a survey targeting tourists travel costs and preferences with regards to forested areas on the island. A tourist-targeted travel cost survey will seek to collect information on country of origin, costs of international travel, frequency of visits to the country, frequency of visits to forest areas, preferred residence whilst on the island, and any related spending and socio-demographics similar to those queried for Chapter 3.

Repanshek (2010) reported that for 2010 the USNPS spent half of the revenues parks collected on asset repairs and maintenance; about 20% on visitor services; another 20% on administration and operations. He reported that only about ten percent of revenues get directed to habitat restoration activities. This suggests that on the island too, public and private forest managers may have pressing repair and maintenance needs (e.g. bridges, tracks, access vehicles) that can pre-dominate the allocation of funds raised from entry fees, at the expense of forest conservation and restoration work. Future economic

assessments of forest management on the island will benefit from cost benefit

assessments measuring revenue trends against predicted expenses (infrastructure,

conservation, visitor services) that apply to different sites.

With regards to the use of CSR funds for conservation activities, the Government budget

2016/2017 proposed the creation of a National CSR Foundation under the aegis of the

Ministry of Social Integration and Economic Empowerment and which will be led by

Directors from the public sector, the private sector and civil society (Ministry of Finance,

2016). The CSR framework was modified such that corporations are now required to

have 50 to 75% of their mandated 2% profit allocation, disbursed to the Foundation. The

Foundation's priority areas are listed as poverty alleviation, educational support, social

housing, supporting people with severe disabilities; dealing with health problems

resulting from substance abuse and poor sanitation; and providing protection to victims of

domestic violence (Ministry of Finance, 2016). Thus, only between 25 to 50% of CSR

money can be made directly available for biodiversity and forest conservation projects,

subject to the corporation's choice. This implies that CSR money may not be as easily

available for conservation financing as some stakeholders might expect.

Chapter 4 relied on a focus group meeting and subsequent in-person interviews with

stakeholders willing to participate in the study between May and August 2015. Time

constraints and scheduling conflicts filtered out many stakeholders. The interview

process itself is a lengthy means of gathering SWOT AHP data. Margles et al. (2010)

used group sessions between stakeholders to collectively establish factor priorities.

Putting stakeholders into small groups to discuss priorities can eliminate issues of biases

and subjectivity in stakeholders' choices and preferences. Use of software like Expert

Choice^{TM} can also drastically reduce the time it takes to compute priorities. Future

application of SWOT AHP should target a larger number of participants and include

randomly selected members of the public as a stakeholder group. SWOT AHP as a

methodology is not for exclusive application to biodiversity and conservation related

policy but rather a tool that can engage stakeholders for a wide array of national projects.

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Appendix I

SURVEY OF VISITORS TO PRIVATE ECO-TOURISM SITES AND THEIR PERCEPTIONS AND VALUE ATTACHED TO NATIVE FORESTS

Hello! I'm Pricila Iranah, a doctoral candidate at Montclair State University in the United States. We are inviting you to participate in a survey about native forest management in Mauritius. I have randomly approached you. Your answers will inform us about your perceptions and values attached to native forest conservation.

Mauritius, is exposed to unique challenges that impact upon how much conservation is done. They also affect how successful conservation is. The objective of this research is to determine the value attached to native forests on state and private lands.

We designed this survey to estimate your willingness to pay for forest conservation in places you visit. A hypothetical scenario has been created. It suggests what an extra amount will contribute to.

The response you provide in this survey is strictly confidential. Final results will be in summary form only. No individual answers can be identified. This survey is voluntary. However, you can help us immensely by taking about 10 minutes to complete the survey. There is no right or wrong answer – we are interested in your opinions. You can terminate the interview whenever you want without consequences.

If you have any question or comment about the study, please contact: Pricila Iranah, Doctoral Candidate, phone: +230.5814.1974, email: iranahp1@mail.montclair.edu, or Dr Pankaj Lal, Assistant Professor Environmental Economics, phone: +1-973-655-3137, email: lalp@mail.montclair.edu. Address for both is Department of Earth and

Environmental Studies, Montclair State University, 1, Normal Avenue, Montclair NJ

07043, USA. Site: _____

SECTION II – GENERAL QUESTIONS

Please circle one number from the scale of 5 (Extremely familiar) to 1 (Not at all familiar).	Not at all familiar	Slightly familiar	Moderately familiar	Very familiar	Extremely familiar
1. "Native" forests are natural areas with species that came to an area naturally, often long before humans. How familiar are you with the term "native forest"?	1	2	3	4	5
2. The term "ecosystem" describes the whole unit that links plants and animals to their non-living environment (soils, water). It includes the relationships between the different components. How familiar are you with the term "ecosystem"?	1	2	3	4	5
3. The term "ecosystem services" describes the goods and services that nature provides directly or indirectly. These benefit humans e.g. oxygen production, freshwater, soil fertility, timber, wild fruits. How familiar are you with the term "ecosystem services"?	1	2	3	4	5
4. Invasive Alien Species (IAS) are species introduced by humans in areas where they do not naturally occur. They spread to such an extent that they threaten the native biological diversity. How familiar are you with the term "invasive species"?	1	2	3	4	5

5. Select which of the following are invasive species according to you.

Strawberry Guava □ Ravenale □ Trochetia □ Bois de Ronde □ Pic pic □ Monkeys □ Deer □ Bats □

6. Please rate how important each of the following goods and services are for you. Circle one number from the scale of 5 (Highly important) to 1 (Least important)	Least Important		Somewhat Important		Highly Important
Good supply of clean water	1	2	3	4	5
Less storm runoff. Flood control	1	2	3	4	5
Lessen impacts of changing climate	1	2	3	4	5

Habitat for wildlife	1	2	3	4	5
Open space for recreation	1	2	3	4	5
Provide products (wild fruits, wood, plants)	1	2	3	4	5
Add value to property	1	2	3	4	5
Sense of well-being and contact with nature	1	2	3	4	5

7. Please rate how well you feel native forests of Mauritius provide the services listed above by circling one number from 5 (Extremely well provided) to 1 (Provided very poorly)	**I don't know**	**Provided very poorly**		**Provided somewhat**		**Provided extremely well**
	0	1	2	3	4	5

8. Please rate how important you feel the following forest management goals are by circling one number from 5 (Most important) to 1 (Least important)	**Least Important**		**Somewhat Important**		**Most Important**
Manage for future generations	1	2	3	4	5
Manage for habitat preservation	1	2	3	4	5
Manage for species preservation	1	2	3	4	5
Manage for watershed capacity	1	2	3	4	5
Lessen impacts of climate change	1	2	3	4	5
Manage for public access	1	2	3	4	5
Create public education	1	2	3	4	5
Manage for aesthetics/beauty	1	2	3	4	5

9. Are you a resident or tourist? Resident □   Tourist □

10. If you are a resident please tell from where you started your day……………………………………………………………………………

11. If you are a tourist, please tell us your country of origin………………………………………………………………………….

12. Please tell us the frequency of your visit to this site		**13.** Please tell us the timing of your visit(s)	
This is my first visit	□	This is my first visit	□
Less than once a year	□	Weekend mornings	□
About once a month	□	Weekend afternoons	□

| Several times a week | □ | Weekday mornings | □ |
| Every day | □ | Weekday afternoons | □ |

14. Please tell us the purpose of your visit		**15.** Please select how you came to the site	
Scientific interest / Research	□	Family car	□
Sports, Exercise and Fitness	□	Minivan	□
Enjoy nature and outdoors	□	Walking	□
Socialize with friends and family	□	Bus	□
Reduce stress	□	Bicycle	□
Collect wild fruits for own use	□	Motorbike	□
Collect wild fruits for commercialization	□	**16.** Please tell us if you are here by yourself or as a group	
Other (please specify)	□	I am here by myself □	

17. Please tell us how long you expect your visit to last.

I am here with ……………… adults

More than 4 hours	□
2 to 4 hours	□
More than 1 hour but less than 2 hours	□
30 to 60 minutes	□
Less than 30 minutes	□
I don't know	□

I am here with ………….. teens under 18.

18. Please rate how well you agree with the following statements, circling one number from 5 (Strongly Agree) to 1 (Strongly disagree)	I don't know	I do not agree		Somewhat Agree		Strongly Agree
Forests in Mauritius, are well protected	0	1	2	3	4	5
Native species are at risk of extinction	0	1	2	3	4	5
Only professionals should decide how the park should be managed	0	1	2	3	4	5
I am well informed about biodiversity loss in Mauritius	0	1	2	3	4	5
I always consider the environmental quality of site before visiting	0	1	2	3	4	5

Conservation of biodiversity is a moral obligation	0	1	2	3	4	5
Biodiversity loss will affect the country's economy	0	1	2	3	4	5
Biodiversity is essential for production of goods and medicine	0	1	2	3	4	5

19. Please select which of the following do you think are causes of biodiversity loss in Mauritius

Intensive farming	□	Deforestation	□	Invasive Alien Species	□
Climate change	□	Over-population	□	Water pollution	□
Air pollution	□	Roads and buildings	□	Cyclones	□

Other (specify)…………………………………

20. Please rate these four areas in terms of their relative importance for Government spending, with 1 being the most important, 2 is the next most important, 3 is the third most important and 4 is the least important.

Education ………….. Crime …………. Environment ………. Unemployment ………….

SECTION III – WILLINGNESS TO PAY

Native forests are an important source of oxygen and freshwater for everyone on the island. However our forests are heavily threatened by invasive alien species, deforestation and degradation. Managing and restoring forests costs money, but the benefits are a lot more. Restoration is not difficult. But it requires tools and labor. If nothing is done, the forest becomes a plantation of one or a few invasive species only. We lose forest function and diversity. Prior studies have shown that there is a significant difference between what people SAY they would be willing to pay, and what they would ACTUALLY pay. Please pretend that the choice offered to you in the next question is real. Please provide an honest answer, keeping in mind your own budget. You have paid an entry fee for this site. The money go mainly for site maintenance and salaries. To enable a greater extent of forest restoration an <u>extra amount on the entry fee</u>, in the form of a <u>conservation levy</u>, would be helpful. This levy would raise funds for the land owners/managers to remove invasive alien species faster and over a larger area. This would help native forest recover more quickly and increase the quality and quantity of ecosystem goods and services.

21. Would you be willing to pay an **EXTRA** MUR [10%, 25%, 50%, 75%, 100%] per person to enter this site?   Yes □
    No □

22. If you have are not willing to pay an extra fee, please tell us why.
I don't believe that the funds will go to conservation of the forest □
The entry fee is already expensive for me □

I do not have the financial capability to invest in conservation □
I do not care for biodiversity issues □
The government should pay □
Only the owners or big corporations should pay □
I do not think that our forests and biodiversity are at risk □
The benefits are too distant/I don't care for future generations □
I don't have enough information about the threats to forests and the conservation measures □
Other (please specify) ……………………………………………………………….

SECTION IV – BACKGROUND INFORMATION

23. Please select your age group	18-29	30-39	40-49	50-59	Above 60
	□	□	□	□	□

24. Gender	25. Please select your ethnicity						
Male □	Franco-Mauritian	Indo-Mauritian	Sino-Mauritian	Creole	Caucasian	Asian	Prefer not to answer
Female □	□	□	□	□	□	□	□

26. Please select the highest level of schooling you have completed.		27. Please select the category best representing your supervisory role:	
Certificate of Primary Education	□	I do not supervise	□
School Certificate	□	I am the lead worker in my unit	□
Higher School Certificate /Baccalaureate	□	I supervise a single unit of employees	□
Trade/technical/vocational diploma	□	I supervise two or more units, each unit having an individual supervisor	□
Bachelor's degree	□	I supervise a major division of an agency or department	□
Masters degree	□	I supervise an entire agency or department	□
Doctoral degree	□	I supervise more than one agency or department	□
Prefer not to answer	□		

28. Please identify your marital status	Single □	Married □	Divorced/Separated □	Partnership □	Widowed □

29. Number of children?	None □	1 □	2 □	More than 2 □

30. If you are a resident please identify your monthly income bracket.	31. If you are a tourist, please identify your annual household income bracket. Country's currency:

	……………………………		
Less than or equal to MUR 5,000	□	Less than 10,000	□
MUR 5,001 to MUR 15,000	□	10,001 to 30,000	□
MUR 15,001 to MUR 30,000	□	30,001 to 50,000	□
MUR 30,001 to MUR 50,000	□	50,001 to 100,000	□
MUR 50,001 to MUR 100,000	□	More than 100,000	□
More than MUR 100,000	□	Country currency …………………………….	

SURVEY OF VISITORS TO STATE FORESTS AND THEIR PERCEPTIONS

AND VALUE ATTACHED TO NATIVE FORESTS

Hello! I'm Pricila Iranah, a doctoral candidate at Montclair State University in the United States. We are inviting you to participate in a survey about native forest management in Mauritius. I have randomly approached you. Your answers will inform us about your perceptions and values attached to native forest conservation.

Mauritius, is exposed to unique challenges that impact upon how much conservation is done. They also affect how successful conservation is. The objective of this research is to determine the value attached to native forests on state and private lands.

We designed this survey to estimate your willingness to pay for forest conservation in places you visit. A hypothetical scenario has been created. It suggests what an extra amount will contribute to.

The response you provide in this survey is strictly confidential. Final results will be in summary form only. No individual answers can be identified. This survey is voluntary. However, you can help us immensely by taking about 10 minutes to complete the survey. There is no right or wrong answer – we are interested in your opinions. You can terminate the interview whenever you want without consequences.

If you have any question or comment about the study, please contact: Pricila Iranah, Doctoral Candidate, phone: +1-973-655-3456, email: iranahp1@mail.montclair.edu, or Dr Pankaj Lal, Assistant Professor Environmental Economics, phone: +1-973-655-3137, email: lalp@mail.montclair.edu. Address for both is Department of Earth and

Environmental Studies, Montclair State University, 1, Normal Avenue, Montclair NJ 07043, USA.   Site: _____

SECTION II – GENERAL QUESTIONS

Please circle one number from the scale of 5 (Extremely familiar) to 1 (Not at all familiar).	Not at all familiar	Slightly familiar	Moderately familiar	Very familiar	Extremely familiar
1. "Native" forests are natural areas with species that came to an area naturally, often long before humans. How familiar are you with the term "native forest"?	1	2	3	4	5
2. The term "ecosystem" describes the whole unit that links plants and animals to their non-living environment (soils, water). It includes the relationships between the different components. How familiar are you with the term "ecosystem"?	1	2	3	4	5
3. The term "ecosystem services" describes the goods and services that nature provides directly or indirectly. These benefit humans e.g. oxygen production, freshwater, soil fertility, timber, wild fruits. How familiar are you with the term "ecosystem services"?	1	2	3	4	5
4. Invasive Alien Species (IAS) are species introduced by humans in areas where they do not naturally occur. They spread to such an extent that they threaten the native biological diversity. How familiar are you with the term "invasive species"?	1	2	3	4	5

5. Select which of the following are invasive species according to you.
Strawberry Guava □   Ravenale □   Trochetia □   Bois de Ronde □   Pic pic □   Monkeys □   Deer □   Bats □

6. Please rate how you value each of the following goods and services by circling one number from the scale of 5 (Highly valued) to 1 (Least valued)	Least Valued		Somewhat valued		Highly valued
Good supply of clean water	1	2	3	4	5
Less storm runoff. Flood control	1	2	3	4	5
Lessen impacts of changing climate	1	2	3	4	5
Habitat for wildlife	1	2	3	4	5
Open space for recreation	1	2	3	4	5
Provide products (wild fruits, wood, plants)	1	2	3	4	5

		I don't know	Provided very poorly		Provided somewhat		Provided extremely well
Add value to property			1	2	3	4	5
Sense of well-being and contact with nature			1	2	3	4	5

7. Please rate how well you feel native forests of Mauritius provide the services listed above by circling one number from 5 (Extremely well provided) to 1 (Provided very poorly)

	I don't know	Provided very poorly		Provided somewhat		Provided extremely well
	0	1	2	3	4	5

8. The nature reserves and national parks of Mauritius are managed by the Forestry Service and the National Parks and Conservation Service of the Government. Please rate how important you feel the following management goals are by circling one number from 5 (Most important) to 1 (Least important)

	Least Important		Somewhat Important		Most Important
Manage for future generations	1	2	3	4	5
Manage for habitat preservation	1	2	3	4	5
Manage for species preservation	1	2	3	4	5
Manage for watershed capacity	1	2	3	4	5
Lessen impacts of climate change	1	2	3	4	5
Manage for public access	1	2	3	4	5
Create public education	1	2	3	4	5
Manage for aesthetics/beauty	1	2	3	4	5

9. Are you a resident or tourist?   Resident ☐   Tourist ☐

10. If you are a resident please tell from where you started your day
……………………………………………………………………

11. If you are a tourist, please tell us your country of origin
……………………………………………………………………

12. Please tell us the frequency of your visit to the park		**13.** Please tell us the timing of your visit(s)	
This is my first visit	☐	This is my first visit	☐
Less than once a year	☐	Weekend mornings	☐
About once a month	☐	Weekend afternoons	☐
Several times a week	☐	Weekday mornings	☐

Every day	□	Weekday afternoons	□

14. Please tell us the purpose of your visit		**15.** Please select how you came to the park	
Scientific interest / Research	□	Family car	□
Sports, Exercise and Fitness	□	Minivan	□
Enjoy nature and outdoors	□	Walking	□
Socialize with friends and family	□	Bus	□
Reduce stress	□	Bicycle	□
Collect wild fruits for own use	□	Motorbike	□
Collect wild fruits for commercialization	□	**16.** Please tell us if you are here by yourself or as a group	
Other (please specify)	□	I am here by myself	□
17. Please tell us how long you expect your visit to last.		I am here with ……………… adults	
		I am here with ………….. teens under 18.	
More than 4 hours	□		
2 to 4 hours	□		
More than 1 hour but less than 2 hours	□	Less than 30 minutes	□
30 to 60 minutes	□	I don't know	□

18. Please rate how well you agree with the following statements, circling one number from 5 (Strongly Agree) to 1 (Strongly disagree)	**I don't know**	**I do not agree**		**Somewhat Agree**		**Strongly Agree**
Forests in Mauritius are well protected	0	1	2	3	4	5
Native species are at risk of extinction	0	1	2	3	4	5
Only professionals should decide how the park should be managed	0	1	2	3	4	5
I am well informed about biodiversity loss in Mauritius	0	1	2	3	4	5
I always consider the environmental quality of site before visiting	0	1	2	3	4	5
Conservation of biodiversity is a moral obligation	0	1	2	3	4	5

Biodiversity loss will affect the country's economy	0	1	2	3	4	5
Biodiversity is essential for production of goods and medicine	0	1	2	3	4	5

19. Please select which of the following do you think are causes of biodiversity loss in Mauritius

Intensive farming	□	Deforestation	□	Invasive Alien Species	□
Climate change	□	Over-population	□	Water pollution	□
Air pollution	□	Building of roads and buildings			□
Cyclones	□	Other (specify)………………………………………………………………………………			

20. Please rate these four areas in terms of their relative importance for Government spending, with 1 being the most important, 2 is the next most important, 3 is the third most important and 4 is the least important.

Education ………….. Crime …………. Environment ………. Unemployment ………….

SECTION III – WILLINGNESS TO PAY

Native forests are an important source of oxygen and freshwater for everyone on the island. However our forests are heavily threatened by invasive alien species, deforestation and degradation. Managing and restoring forests costs money, but the benefits are a lot more. Restoration is not difficult. But it requires tools and labor. If nothing is done, the forest becomes a plantation of one or a few invasive species only. We lose forest function and diversity. Prior studies have shown that there is a significant difference between what people SAY they would be willing to pay, and what they would ACTUALLY pay. Please pretend that the choice offered to you in the next question is real. Please provide an honest answer, keeping in mind your own budget. Entrance to this site is currently free. An entry fee would help the Government agencies raise funds to remove invasive alien species faster and over a larger area. This would help the forest recover more quickly. It would increase the quality and quantity of ecosystem goods and services.

21. Would you be willing to pay an entry fee per person to enter this site?   Yes □   No □

22. You have been given a list of prices for hiking at other sites in Mauritius. With those in mind, what do you think would be a fair entry price per person for this site?   ……………………… MUR

23. If you have are not willing to pay an entry fee, please tell us why.

I don't believe that the funds will go to conservation of the park	□
I do not have the financial capability to invest in conservation or pay any entry fee	□
I do not care for biodiversity issues	□
The government should pay	□

Only big corporations should pay	□
I do not think that our forests and biodiversity are at risk	□
The benefits are too distant/I don't care for future generations	□
I don't have enough information about the threats to forests and the conservation measures	□

Other (please specify) …………………………………………………………………….

SECTION IV – BACKGROUND INFORMATION

24. Please select your age group	18-29	30-39	40-49	50-59	Above 60
	□	□	□	□	□

25. Gender	**26.** Please select your ethnicity
Male □	Caucasian □ Franco-Mauritian □ Indo-Mauritian □ Sino-Mauritian □ Creole □
Female □	Asian □ Prefer not to answer □

27. Please select the highest level of schooling you have completed.		**28.** Please select the category best representing your supervisory role:	
Certificate of Primary Education	□	I do not supervise	□
School Certificate	□	I am the lead worker in my unit	□
Higher School Certificate /Baccalaureate	□	I supervise a single unit of employees	□
Trade/technical/vocational diploma	□	I supervise two or more units, each unit having an individual supervisor	□
Bachelor's degree	□	I supervise a major division of an agency or department	□
Masters degree	□	I supervise an entire agency or department	□
Doctoral degree	□	I supervise more than one agency or department	□
Prefer not to answer	□		

29. Please identify your marital status: Single □   Married □   Divorced/Separated □   Partnership □   Widowed □

30. Number of children?   None □   1 □   2 □   More than 2 □

31. If you are a resident please identify your monthly income bracket.		**32.** If you are a tourist, please identify your annual household income bracket. Country's currency: ……………………………..	
Less than MUR 5,000	□	Less than 10,000	□
MUR 5,001 to MUR 15,000	□	10,001 to 30,000	□

MUR 15,001 to MUR 30,000	☐	30,001 to 50,000	☐
MUR 30,001 to MUR 50,000	☐	50,001 to 100 000	☐
MUR 50,001 to MUR 100,000	☐	More than 100 000	☐
More than MUR 100,000	☐		

Appendix II

Plate 1: Inside Brise Fer, one of the best restored CMAs in the Black River Gorges

National Park. Photo courtesy of Dr F.B.V. Florens
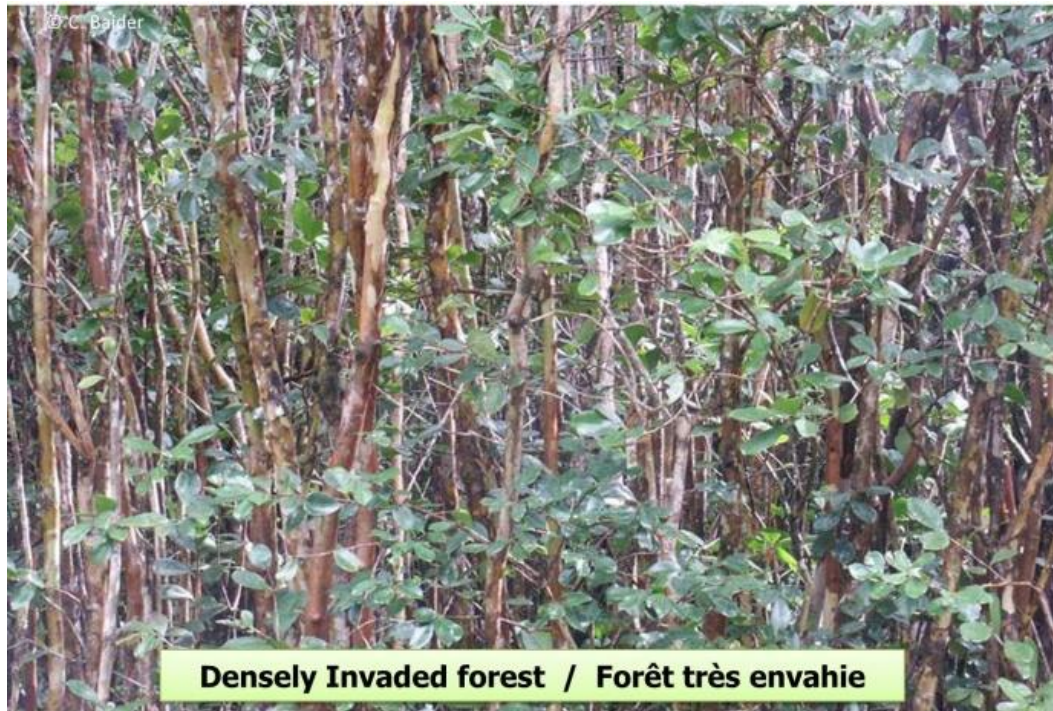
Plate 2: Forest densely invaded with Psidium cattleianum. Photo courtesy of Dr Cláudia

Baider

Plate 3: A set of native animal and plant species.

Plate 4: A set of introduced, invasive animal and plant species.

Plate 5: Picture of a forest with a canopy of invasive alien species. Photo courtesy of Dr

John Mauremootoo.

Plate 6: Picture of laborer in a restoration project, weeding out *Psidium cattleianum*.

Appendix III – Contingent Valuation data summaries

Response distributions by questions for the Contingent Valuation surveys:

Response distribution by site
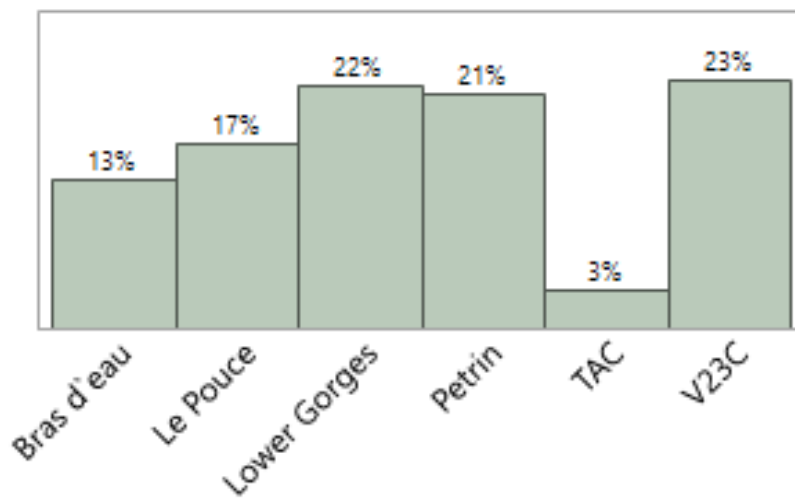
Question 1

Mean	2.6478873
Std Dev	1.5730507
Std Err Mean	0.1077837
Upper 95% Mean	2.8603523
Lower 95% Mean	2.4354223

Question 2

Mean	3.5186916
Std Dev	1.4198876
Std Err Mean	0.0970615
Upper 95% Mean	3.7100158
Lower 95% Mean	3.3273674

Question 3

Mean	2.1415094
Std Dev	1.4825281
Std Err Mean	0.1018204
Upper 95% Mean	2.3422251
Lower 95% Mean	1.9407938

Question 4

Mean	2.7523364
Std Dev	1.6183714
Std Err Mean	0.1106296
Upper 95% Mean	2.9704055
Lower 95% Mean	2.5342674

Question 5

	Yes (%)	No or Don't Know (%)
Psidium cattleianum var. sabine	39	61
Ravenala madagascariensis	24	76
Trochetia boutonianna	13	87
Erythroxylum sideroxyloides	10	90
Zosterops mauritanus	43	57
Macaca fascicularis	43	57
Cervus timorensis	20	80
Pteropus niger	56	44

Question 6

	Mean	Std Dev	Std Err Mean	Upper 95% Mean	Lower 95% Mean
Good supply of clean water	4.6448598	1.0323621	0.0705708	4.7839665	4.5057532
Less storm runoff. Flood control	4.3849765	1.2597393	0.0863159	4.5551239	4.2148291
Lessen impacts of changing climate	4.5164319	1.1014409	0.0754695	4.6651987	4.3676652

Habitat for wildlife	4.6103286	0.96802	0.0663276	4.7410748	4.4795825
Open space for recreation	4.5446009	0.8870831	0.0607819	4.6644153	4.4247866
Provide products (wild fruits, wood, plants)	3.9252336	1.5179733	0.1037665	4.1297745	3.7206928
Add value to property	4.0566038	1.3722379	0.0942457	4.2423875	3.87082
Sense of well-being and contact with nature	4.8450704	0.5314954	0.0364175	4.9168572	4.7732837

Question 7

Mean	3.0215054
Std Dev	1.1898535
Std Err Mean	0.0872443
Upper 95% Mean	3.193627
Lower 95% Mean	2.8493837

Question 8

	Mean	Std Dev	Std Err Mean	Upper 95% Mean	Lower 95% Mean
Manage for future generations	4.8254717	0.5615755	0.0385692	4.901502	4.7494414
Manage for habitat preservation	4.8349057	0.5727695	0.039338	4.9124514	4.7573599
Manage for species preservation	4.8679245	0.5433872	0.03732	4.9414923	4.7943567
Manage for watershed capacity	4.7857143	0.6465112	0.0446135	4.8736644	4.6977641
Lessen impacts of climate change	4.7122642	0.7648936	0.0525331	4.8158211	4.6087072
Manage for public access	4.3981043	1.0835551	0.074595	4.5451553	4.2510533
Create public education	4.759434	0.7112206	0.0488468	4.8557243	4.6631436
Manage for aesthetics/beauty	4.1706161	1.2758896	0.0878359	4.3437691	3.9974631

Question 9

Residents	77 %
International visitors	23 %

Question 12

This is my first visit	41 %
Less than once a year	28 %
About once a month	18 %
Several times a week	9 %
About once a week	2 %
Every day	2 %

Question 13

This is my first visit	24 %
Weekday mornings	46 %
Weekday afternoons	16 %
Weekend mornings	9 %
Weekend afternoons	5 %

Question 14 (Multiple selections)

Scientific interest / Research	0.5 %
Sports, Exercise and Fitness	33 %
Enjoy nature and outdoors	54 %
Socialize with friends and family	51 %
Reduce stress	30 %
Collect wild fruits for own use	2 %
Collect wild fruits for commercialization	0
Other	4 %

Question 15

Family or Rental car	72 %
Minivan	5 %
On foot	8 %
Bus	12 %
Bicycle	1 %
Motorbike	2 %

Question 16

Visitors travelling alone = 9 %

Number of accompanying adults = 193

Number of accompanying teens under 18 years old = 86

Question 17

More than 4 hours	27 %
Between 2 and 4 hours	45 %
Between 1 and 2 hours	18 %
Between 30 minutes and 1 hour	7 %
Less than 30 minutes	1 %
I don't know	1 %

Question 18

	Mean	Std Dev	Std Err Mean	Upper 95% Mean	Lower 95% Mean
Forests in Mauritius are well protected	2.5759162	1.5194341	0.1099424	2.7927807	2.3590518
Native species are at risk of extinction	3.9417989	1.4483295	0.1053505	4.1496199	3.733978
Only professionals should decide how	2.3267327	1.7225973	0.1212015	2.5657223	2.0877431

the park should be managed					
I am well informed about biodiversity loss in Mauritius	1.9795918	1.4427864	0.1030562	2.1828396	1.776344
I always consider the environmental quality of site before visiting	3.15	1.7240539	0.121909	3.3903993	2.9096007
Conservation of biodiversity is a moral obligation	4.6268657	1.0124597	0.0714134	4.7676855	4.4860459
Biodiversity loss will affect the country's economy	4.4527363	1.090415	0.0769119	4.6043987	4.3010739
Biodiversity is essential for production of goods and medicine	4.5422886	0.9052363	0.0638504	4.668195	4.4163821

Question 19 (Multiple selections)

Intensive farming	28 %
Climate change	39 %
Air pollution	51 %
Cyclones	33 %
Deforestation	66 %
Over population	45 %
Invasive Alien Species	37 %
Water pollution	53 %
Infrastructure	72 %
Other	18 %

Question 20

	Ranked Most Important 1	Ranked 2	Ranked 3	Ranked Least Important 4
Crime	14 %	13 %	22 %	43 %
Education	57 %	20 %	10 %	4 %
Environment	9 %	27 %	28 %	28 %
Unemployment	20 %	28 %	28 %	14 %

Question 24

Age Group	Percentage
18 to 29	40
30 to 39	25
40 to 49	16
50 to 59	12
60 and above	7

Question 25

Gender Female = 38%

Gender Male = 62%

Question 26

Ethnicity	Percentage
Franco-Mauritian	4
Indo-Mauritian	44
Sino-Mauritian	5
Creole	13
Asian	9
Caucasian	14
Prefer not to answer	11

Question 27

Schooling	Percentage
Certificate of Primary Education	12
School Certificate	18
Higher School Certificate /Baccalaureate	19
Trade/technical/vocational diploma	11
Bachelor's degree	16
Masters degree	19
Doctoral degree	2
I prefer not to answer	2

Question 28

Supervisory level	Percentage
I do not supervise	46
I am the lead worker in my unit	16
I supervise a single unit of employees	20
I supervise two or more units, each unit having an individual supervisor	10
I supervise a major division of an agency or department	3
I supervise an entire agency or department	3
I supervise more than one agency or department	1

Question 29

Marital status	Percentage
Single	38
Married	55
Divorced/Separated	2
Partnership	4
Widowed	1

Question 30

Number of Children	Percentage
None	56
1 child	14
2 children	17
More than 2 children	14

Question 31 and 32

Annual income bracket (USD)	Percentage
Less than or equal to 2000	14
2001 to 5000	28
5001 to 12000	18
12001 to 18000	10
18001 to 30000	11
30001 to 50000	12
500001 to 100000	3
100000 to 150000	3

Appendix IV

SURVEY OF VISITORS' TRAVELLING COSTS TO FOREST SITES IN THE

REPUBLIC OF MAURITIUS

Hello! I'm Pricila Iranah, a doctoral candidate at Montclair State University in the

United States. We are inviting you to participate in a survey about native forest

management in Mauritius. I have randomly approached you. Your answers will inform

us about your perceptions and values attached to native forest conservation.

Mauritius, is exposed to unique challenges that impact upon how much conservation is

done. They also affect how successful conservation is. The objective of this research is

to determine the value attached to native forests on state and private lands. We designed

this survey to estimate your willingness to pay for forest conservation in places you visit,

by assessing the investment you are incurring travelling to different sites.

The response you provide in this survey is strictly confidential. Final results will be in

summary form only. No individual answers can be identified. This survey is voluntary.

However, you can help us immensely by taking about 30 minutes to complete the survey.

There is no right or wrong answer – we are interested in your opinions. You can

terminate the interview whenever you want without consequences.

If you have any question or comment about the study, please contact: Pricila Iranah,

Doctoral Candidate, phone: +230.5814.1974, email: iranahp1@mail.montclair.edu, or Dr

Pankaj Lal, Assistant Professor Environmental Economics, phone: +1-973-655-3137,

email: lalp@mail.montclair.edu. Site: _____

SECTION II – GENERAL QUESTIONS

1. Please rate how well you agree with the following statements, circling one number from 5 (Strongly Agree) to 1 (Strongly disagree)	I don't know	I do not agree		Somewhat Agree		Strongly Agree
Forests in Mauritius are well protected	0	1	2	3	4	5
Native species are at risk of extinction	0	1	2	3	4	5
Only professionals should decide how a park/reserve should be managed	0	1	2	3	4	5
I am well informed about biodiversity loss in Mauritius	0	1	2	3	4	5
I always consider the environmental quality of site before visiting	0	1	2	3	4	5
Conservation of biodiversity is a moral obligation	0	1	2	3	4	5
Biodiversity loss will affect the country's economy	0	1	2	3	4	5
Biodiversity is essential for production of goods and medicine	0	1	2	3	4	5

SECTION III – TRAVEL COST

2. If you are a resident please tell us from where you started your day …………………………………………………..

3. Please estimate the time and distance it took for you to get to this site from your point of origin

Time: ……………………………….. hrs/min

Distance: ……………………………. km/miles

4. If you had not come to this site today, which of the following activities would you most likely be doing?

Working at my job	□	Watching TV	□
Housework/Shopping	□	Socializing	□
Visiting another location	□		

5. Please tell us the frequency of your visit to the park		6. Please tell us the timing of your visit(s)	
This is my first visit	□	This is my first visit	□
Less than once a year	□	Weekend mornings	□
About once a month	□	Weekend afternoons	□
Several times a week	□	Weekday mornings	□
Every day	□	Weekday afternoons	□

7. Please tell us the purpose of your visit		**8.** Please select how you came to the park	
Scientific interest / Research	□	Family car	□
Sports, Exercise and Fitness	□	Minivan	□
Enjoy nature and outdoors	□	Walking	□
Socialize with friends and family	□	Bus	□
Reduce stress	□	Bicycle	□
Collect wild fruits for own use	□	Motorbike	□
Collect wild fruits for commercialization	□	**9.** Please tell us if you are here by yourself or as a group	
Other (please specify)……………………………..	□	I am here by myself	□
		I am here with ……………… adults	
10. Please tell us how long you expect your visit to last.		I am here with ………….. teens under 18.	
More than 4 hours	□	**11.** Please tell us how much you have spent on your trip to this site	
2 to 4 hours	□	Transportation MUR………… (if public transport, taxi or hired vehicle)	
More than 1 hour but less than 2 hours	□	Fuel MUR ……………………… Food MUR……………………	
30 to 60 minutes	□	Entry Fee MUR………. per adult	
Less than 30 minutes	□	MUR………. per child	
		12. Have you visited or will you visit other sites today? Please list them	
13. Do you know of any other national park or eco-tourism site that you would like to visit instead of this site? Please provide a name.		……………………………………………………	
		……………………………………………………	
14. How much time would you spend at that alternate site?		………………………………………………. hrs/minutes	

SECTION IV – BACKGROUND INFORMATION

15. Please select your age	18-29	30-39	40-49	50-59	Above 60	**16.** Gender?

| | □ | □ | □ | □ | □ | Male □ | Female □ |

17. Please select your ethnicity	**18.** Marital Status?
Franco-Mauritian Sino-Mauritian Creole Asian □ □ □ □ Indo-Mauritian □ Caucasian □ Prefer not to answer □	Single Married □ Divorced □ □ Separated Partnership □ □

19. Please select the highest level of schooling you have completed.		**20.** Please select the category best representing your supervisory role:	
Certificate of Primary Education	□	I do not supervise	□
School Certificate	□	I am the lead worker in my unit	□
Higher School Certificate /Baccalaureate	□	I supervise a single unit of employees	□
Trade/technical/vocational diploma	□	I supervise two or more units, each unit having an individual supervisor	□
Bachelor's degree	□	I supervise a major division of an agency or department	□
Masters degree	□		
Doctoral degree	□	I supervise an entire agency or department	□
Prefer not to answer	□		
21. Number of children		I supervise more than one agency or department	□
None □ 1 □ 2 □ More than 2 □			

22. If you are a resident please identify your monthly income bracket.		
Less than MUR 5,000	□	MUR 5,000 to MUR 15,000 □
MUR 15,000 to MUR 30,000	□	MUR 30,000 to MUR 50,000 □
MUR 50,000 to MUR 100,000	□	More than MUR 100,000 □

23. Would you like a copy of the final report? Yes □ No □

Appendix V – Travel Cost Data Summaries

Response distribution by site
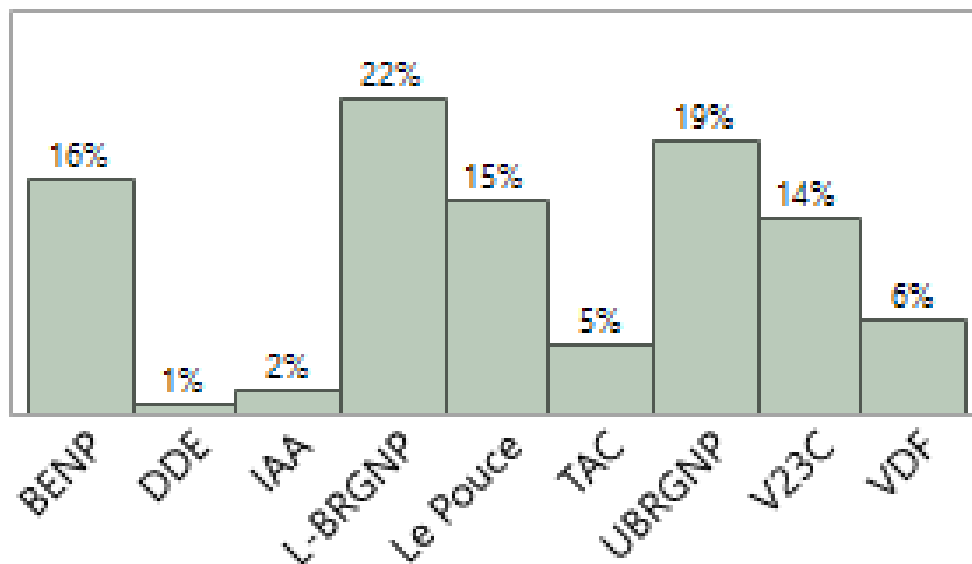
BENP – Bras d'Eau National Park

DDE – Domaine de L'Etoile

IAA – Ile Aux Aigrettes

L-BRGNP – Lower Black River Gorges National Park

Le Pouce Nature Reserve

TAC – Trou aux Cerfs

UBRGNP – Upper Black River Gorges National Park

V23C – La Vallee des 23 Couleurs

VDF – La Vallee de Ferney

Question 1

	Mean	Std Dev	Std Err Mean	Upper 95% Mean	Lower 95% Mean
Forests in Mauritius are well protected	2.6312849	1.4371961	0.1074211	2.8432676	2.4193022
Native species are at risk of extinction	3.6861702	1.4450432	0.1053906	3.8940775	3.4782629
Only professionals should decide how the park should be managed	2.8297872	1.6812161	0.1226153	3.0716742	2.5879003
I am well informed about biodiversity loss in Mauritius	2.6276596	1.4328763	0.1045032	2.8338164	2.4215028
I always consider the environmental quality of site before visiting	3.606383	1.4604818	0.1065166	3.8165116	3.3962544
Conservation of biodiversity is a	4.537234	0.8613488	0.0628203	4.6611616	4.4133065

moral obligation					
Biodiversity loss will affect the country's economy	4.25	1.2393935	0.0903921	4.4283192	4.0716808
Biodiversity is essential for production of goods and medicine	4.393617	0.9217292	0.067224	4.5262319	4.2610021

Question 4

Working at my job	11 %
Housework/Shopping	21 %
Visiting another location	23 %
Watching TV	23 %
Socializing	26 %

Question 6

First visit	18 %
Weekends	74 %
Weekdays	7 %

Question 7(Multiple selections)

Scientific interest / Research	1 %
Sports, Exercise and Fitness	35 %
Enjoy nature and outdoors	59%
Socialize with friends and family	39 %
Reduce stress	32 %
Collect wild fruits for own use	5 %
Collect wild fruits for commercialization	0
Other (please specify)	0

Question 8

Family car	%
Minivan	%
On foot	%
Bus	%
Bicycle	%
Motorbike	%

Question 9

Visitors travelling alone = 21 %

Number of accompanying adults = 126

Number of accompanying teens under 18 years old = 53

Question 15

Age Group	Percentage
18 to 29	21
30 to 39	30
40 to 49	20
50 to 59	17
60 and above	12

Question 16

Gender Female = 38%

Gender Male = 62%

Question 17

Ethnicity	Percentage
Franco-Mauritian	16
Indo-Mauritian	52

Sino-Mauritian	7
Creole	25

Question 18

Marital status	Percentage
Single	26
Married	67
Divorced/Separated	4
Partnership	2
Widowed	1

Question 19

Schooling	Percentage
Certificate of Primary Education	17
School Certificate	19
Higher School Certificate /Baccalaureate	17
Trade/technical/vocational diploma	12
Bachelor's degree	18
Masters degree	14
Doctoral degree	0
I prefer not to answer	3

Question 20

Supervisory level	Percentage
I do not supervise	50
I am the lead worker in my unit	14
I supervise a single unit of employees	18
I supervise two or more units, each unit having an individual supervisor	9
I supervise a major division of an agency or department	5
I supervise an entire agency or department	3
I supervise more than one agency or department	0

Question 21

Number of Children	Percentage
None	33
1 child	21
2 children	28
More than 2 children	18

Question 22

Annual income bracket (USD)	Percentage
Less than or equal to 2000	12
2001 to 5000	27
5001 to 12000	15
12001 to 18000	25
18001 to 30000	10
30001 to 50000	11

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